# SCIENCE

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## *THIRD ANNUAL PURE FOOD AND DRUG CONGRESS.*

IN harmony with a call issued by the Executive Committee, the third annual Pure Food and Drug Congress of the United States, assembled in Washington, D. C., on March 7th.

Delegates to this Congress were appointed by the Governors of the several States; by the State boards of agriculture and health; by the agricultural colleges and experiment stations; by the national trade organizations, both by wholesalers and retailers; by the National Grange; by the State Granges and by various other organized bodies. Over five hundred delegates were appointed and about three hundred attended the meeting, thirty-five States and Territories being represented by delegates in actual attendance. The meeting was a thoroughly representative one in every particular.

The principal object of this Congress was to promote national legislation relating to the inter-state traffic in adulterated foods, to provide inspection of food products shipped abroad and to regulate the sale of food products in the Territories of the United States and the District of Columbia. Under the constitution the power of the Congress cannot go farther than this.

For many years agitation in regard to this legislation has been going on, and the fundamental principles of the measure agreed upon have been endorsed by the

various interests represented in this and the previous Congresses. The necessity for such legislation is apparent to every one. State laws are effective only when supplemented by national legislation. As long as adulterated foods are permitted to enter one State from another it is not possible for the State authorities to reach the real offender. The State courts can only punish the citizens of their own State, whereas the real culprit may reside across the State border in another jurisdiction. One of the best provisions of this measure, which has been endorsed by this Pure Food Congress, is that the original manufacturer or producer of the goods can be punished, while the innocent retailer or dealer may escape, by tracing the articles to their original source, and thus furnish evidence to convict the primary offender.

Another excellent provision of the proposed law, as endorsed by the Congress, is the inspection of food products intended for export to foreign countries. It is well known that many of our food products have been unjustly condemned in foreign countries, on alleged sanitary grounds or on alleged imperfections. Inasmuch as these food products have received no inspection before leaving the country it is quite difficult for our citizens to establish the character and purity of their exported food products. With rigid inspection by Government officials, before export, it would be a comparatively easy matter to maintain the rights of our food products in foreign countries. By reason of the increased scope and magnitude of the work of the Division of Chemistry and in harmony with the recommendations contained in the last annual report of the Secretary of Agriculture, to the President of the United States, the proposed legislation endorsed by the Pure Food Congress raises the Division of Chemistry to the dignity of a bureau.

Another excellent feature of the proposed measure is the absence of annoying, restrictive or prohibitive clauses. The pure food bill, as recommended by the Congress, does not inflict upon any honest dealer any rules or regulations, which will interfere in any way with his trade or make it difficult for him to conduct his business.

If the question of wholesomeness arises a provision is made for its study in a thoroughly impartial and effective manner. The bill provides for a board to be appointed by the President of the United States and the Secretary of Agriculture conjointly, consisting of five physicians, three of whom are to represent the Army, Navy and Marine Hospital Service, to be appointed by the President; a board of five experts, who are eminent in physiological chemistry and hygiene, to be appointed by the Secretary of Agriculture; and these together with the Chairman of the Committee on Pure Food Standards of the Association of Official Agricultural Chemists and the Chief Chemist of the Department of Agriculture of the United States, will form a board of twelve persons to whom all matters relating to wholesomeness of food products, or of materials added thereto, will be referred. It is evident that such an unbiased body will be able to reach conclusions, after proper investigations, which will merit the confidence of the country.

The administration of the law is confided to the Secretary of Agriculture, who is authorized to make all needful rules and regulations for carrying out the provisions of the act, and in doing this is to make use of the chemists and appliances of the Division of Chemistry of the Department of Agriculture. This method of administration has been approved of at all of the sessions of the Food Congress as being the wisest, most efficient and the most economical method of securing the purposes in view. The Secretary, at his discretion, can make use of the chemists and appliances of the various States engaged in food inspection, in order to render the

service local, where the infringement of the law may have taken place.

The only element of discord in the Food Congress was developed by a proposal to establish an entirely independent food bureau, with an independent chemical laboratory, for the administration of the law. The head of this bureau, it was proposed, should be appointed by the President, for a term of four years, thus making the administration of the pure food law subject to frequent political changes. This provision was debated at great length for two days and at times with a degree of acrimony which indicated that some of the promoters of pure food legislation were more anxious to secure a new office than to establish a food law. At the end of this discussion the original plan, endorsed by previous Congresses, passed by a large majority and the bill thus approved was adopted without a dissenting vote.

On the third day of the Congress, by the invitation of the Committee on Interstate Commerce of the House of Representatives, a large number of the delegates attended the meeting of the Committee, at which the merits of the bill were presented in five minute speeches, by the representatives of the various industries attending the Congress.

In the interests of the public health and public honesty, it is to be hoped that the measure which has been recommended for the third time by this national Pure Food Congress, and which has the approbation of all the great trade interests of the country, will be pushed to a speedy vote and become a law before the present session of Congress adjourns.

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## *THE ACCURACY OF THE EXPERIMENTAL METHODS OF THE CHEMIST.**

ON occasions like the present, where intellectual labor is the chief aim of those who are assembled together, it is a frequent practice for the speaker to offer to his audience something of the fruit which he has gathered from his own investigations. To the thought which lies at the foundation of this custom, are due those inaugural addresses which can lay just claim to being contributions to scientific knowledge. Other speakers prefer to furnish to these cultured circles a glimpse into the workings and tendencies of the higher institutions of learning. It were to me a great pleasure, esteemed colleagues and fellow students, could my efforts to-day draw me closer to you; at all events this address shall serve as a greeting of welcome from the Rector, now entering upon his office, to all those who are connected with this *Hochschule*, and to all those who feel in it a kindly interest. And it is in this last sense that I beg leave to offer a few thoughts upon

### THE ACCURACY OF THE EXPERIMENTAL METHODS OF THE CHEMIST.

It is the well recognized task of scientific investigation to discover the truth, and in those cases where this is not possible, to approximate it as closely as possible. In the natural sciences we may look upon this goal as attained when it is possible, in the broadest sense of the word *to describe* that which is appreciable to the senses. For this purpose it is generally insufficient merely to allow the object to act directly upon the senses, without in any way modifying its natural conditions; we must avail ourselves of external assistance which either shall like a lens render our observations more accurate, or shall make possible the study of the object under changed outward conditions. On the one hand we use meter stick, balance, microscope; on the other Bunsen burner, electrolytic cell, Röntgen apparatus, and the like. One need but cast a glance into the workshop of our investigator to see what an arsenal of appa-

* Inaugural address of the Rector of the Technischer Hochschule, Graz, Hungary. Translated by J. L. H.

ratus of both these classes stands at the command of the modern investigator in natural science; literally numberless are the conditions under which matter is ever anew compelled to yield up its secrets.

Let us now look more closely at the work of the chemist, that we may learn how far the results attained by the methods at his disposal may lay claim to exactitude.

The task which we have proposed may be treated in different ways. We could from a general standpoint, discuss the criteria by which the accuracy of an experimental method is to be judged. A method will thus be valued as exact according to the concordance of the results attained by it on many repetitions or according to the concordance of these results with those attained by other methods. The fulfilment of this last condition is especially of value, and we shall therefore later recur to an especially interesting case of this kind. The value of a method moreover will be further increased if it is fitted to broaden the field of experimentation; just as a piece of apparatus is of increased value, when it is adaptable for different experiments.

I prefer, however, to pass by these more general considerations and to discuss the exactitude of experimental methods in their bearing upon a few problems, whose fundamental importance is recognized. Of these I select three.

First we will consider the proof of the law of *indestructibility of matter*, as an example of the degree of exactness for which experimental data can be obtained, where the *determination of atomic masses* is concerned.

A second problem will be the *delicacy of chemical reactions*, under which it is to be considered, how far the accuracy of our apparatus allows us to detect the existence of definite chemical substances. And if both of these cases shall lead us to increased confidence in our methods, and we come to feel that the exactness of our experimental methods is very great, our third study on the other hand will serve to shatter this confidence. This study is that of *the absolutely pure substance*, and brings us at once to the point where the experimenter is wholly convinced of the justice of the conclusion that the hands of man can never bring into existence the unconditionally perfect.

Before we enter upon a consideration of these three examples, however, it will be well to notice the case which has already been spoken of, which reveals, as hardly any other could, the fact that those views, which have been attained by very different ways, and which we form from facts and phenomena upon the basis of sentient perception, may coincide to a remarkable degree; this is particularly the case if we take into account the possibility that our observations may not correspond to the reality quite as closely as the investigator commonly claims. In determining the density of the vapor of mercury, if one proceeds on the supposition that all gaseous bodies under the same conditions of temperature and pressure contain the same number of molecules in the same space, he comes to the conclusion that the vapor of mercury contains in the molecule only one-half as many atoms as that of hydrogen. If, as appears from the volume relation in the analysis and synthesis of hydrochloric acid, this hydrogen molecule contains two atoms, it then follows that in the vapor of mercury the smallest particles which exist in a free state are single atoms. Now it is possible to reach this result by a wholly different method. It is a familiar fact that the velocity of sound may be used to determine the relation between specific heats of gases at constant volume and constant pressure. For this determination the knowledge of volume and weight is necessary, and besides this a measure of length, that is the length of the sound waves. The ex-

periment furnishes us for this relation in the case of the vapor of mercury a higher value than in most gases. This ratio is one and two-thirds, that is, it is exactly the figure which is demanded by the kinetic theory of gases for a gas which contains a monatomic molecule, where the atomic energy of the molecule can be neglected when compared with that of the molecule as a whole. The velocity of sound in the lately discovered gases, argon, helium, neon, xenon and krypton, has also been found to correspond to monatomic molecules. This knowledge stands further in beautiful harmony with the chemical properties of these elements, whose atoms—apparently *without affinity*—appear unable to enter into any kind of combination. They seemed doomed to eternal solitude.

We now come to the first of the three problems which we have proposed for our consideration to-day. The question of the indestructibility of matter can best be introduced by recalling the investigations of the distinguished Belgian chemist, Stas, who attained an exactness in his work which has excited the admiration of all succeeding chemists. His investigations especially reveal where the experimental possibilities in this field find their limit. A closer view of his work would unfortunately compel us to enter upon a series of dry studies of figures. We will, however, take one example from among these. In order to prove our law, Stas prepared synthetically three quarters of a kilo of silver iodid, a quantity which the analytical chemist would consider enormous, and he found this weighed only fourteen and one-half milligrams less than the weight of the constituents of the compound. This is an accuracy reaching one fifty-thousandth part of the whole quantity. How extraordinarily close to complete agreement these figures lie may be judged when one considers that in our ordinary gravimetric methods, using perhaps a gram of substance, an error of one milligram may certainly be looked upon as small. This is an error of a one-thousandth of the whole quantity used.

As further experimental contributions to the law we are considering the work of Kreichgauer and that of Landolt is interesting. These investigators have carried on chemical observations in fused glass tubes in order to decide, by most careful weighing, these two questions: whether in a reaction, a ponderable portion of ether disappears or is added to the substances used; and whether the products of a reaction are influenced in exactly the same way by gravity as are the factors which enter into the reaction. Kreichgauer's experiments were calculated to detect a change in weight which would have amounted to one twenty-millionth of the mass present, but even this minute change of weight was not detected. In Landolt's experiments it was also impossible to detect any change in weight, although he did not consider the possibility of such a change absolutely excluded, chiefly because the variations, which were considerably less than one-tenth of a milligram, were always in the same direction.

In more recent times Ramsay and Rayleigh have carried out extremely accurate experiments. These distinguished scientific observers at first set before themselves merely the problem of determining, with the greatest possible accuracy, the weight of a few gases, among others that of nitrogen; but in the course of these investigations they came to the most unexpected results, for they were led to the discovery, and later to the separation of the unknown constituents of the air, argon, xenon, etc., as already mentioned. In such ways, an ever increasing perfection leads to ever more accurate results. And if it be true that in all investigations of this kind we must be denied the possibility of reaching the abso-

lute truth, there is, nevertheless, infinite satisfaction in the consciousness that we may approach nearer and nearer to the goal. The experiments of Ramsay and Rayleigh, however, lead us also to the knowledge that with the perfection of our methods, there may follow also the discovery of wholly new facts; and so investigation and experimentation are always worth while. They also bring as a reward answers even more numerous than the questions proposed. In other words, as in other fields, so also in natural science, one advance seldom takes place alone. In this sense it is not just that we should so frequently speak of notable discoveries being made by accident; for we thus minimize the labors and the deserts of the experimenter in the minds of others who are not familiar with his work.

We pass now to our second example. Methods which have for their aim the qualitative detection of elements are, other things being equal, considered more valuable according as they are more sensitive, that is according as they lead one to his desired end with the use of the least possible quantity of substance. In this respect it seems to be almost universally accepted that the smallest quantity of substance can be recognized, not by special experimental apparatus, but directly through one of our senses—that of smell. On the one hand this assumption rests upon the observation of E. Fischer and Penzoldt, that the limit of perception of the odor of mercaptan is reached when one four hundred and sixty-millionth part of a milligram of the substance is present. On the other hand the work of Kirchhoff and Bunsen shows that by spectrum analysis one fourteen millionth of a milligram of sodium can be recognized with certainty. By this it is not to be understood that Kirchhoff and Bunsen submitted this quantity as the smallest amount of a given element which will suffice to give a spectrum recognizable with certainty, but they merely put forth this statement to show the superiority of the methods of spectrum analysis in general. My own observations, the details of which do not belong here, have at all events convinced me that it is easy to so extend in spectrum analysis the limit of sensitiveness that we must to-day look upon spectrum analysis as by far the most delicate of all analytical methods. It is possible for us to compare the smallest amount of detectible substance with the hypothetical mass of the molecule, that is with the smallest quantity of substance that is capable of existing. In this way we easily reach the perhaps surprising fact that the least quantity of mercaptan perceptible to the senses contains about $2 \times 10^{10}$ molecules. Hence, even of the most penetrating odors, it is necessary for twenty billions of their molecules to bombard the olfactory nerves, before these carry the sensation to the brain; they utterly ignore all smaller quantities. In ordinary analytical methods the quantity of substance is naturally incomparably greater. Without undertaking to weary you with figures I will in general and briefly note that by microchemical methods it is possible to detect about one ten-thousandth of a milligram, while in ordinary test tube reactions, it is desirable to have at least several milligrams of the substance present.

And now we come to the consideration of the last of the problems mentioned. The processes by means of which we decompose the mixtures which nature furnishes us, into their individual constituents, that is obtain from them chemically pure compounds, are of many kinds. We make use of variations in solubility and volatility, of the possibilities of crystallization and diffusion, of chemical, electrical and magnetic relations. These are, in a single word, really gradual differences, which can be used so much the less perfectly as the bodies to be separated resemble each other in phys-

ical and chemical aspects. Purification thus appears a process that can only be worked by degrees, so that we can consider the absolutely pure body wholly as a limiting condition. In the natural sciences it is often desirable to obtain as closely as possible such limiting conditions: for example we may mention the absolute zero, the possibility of which is clearly deducible by a simple consideration of the law of Gay Lussac: the absolute vacuum, a conception usually derived from the fact that the quantity of substance in a given space can be more and more diminished; (we are on the other hand convinced with certainty that it is as little possible to obtain a true vacuum artificially as it is to conceive of it in interplanetary space). Again, the condition of absolute equality of temperature between two bodies in contact, or of a system which is in absolutely complete chemical equilibrium, are purely ideal limiting conditions, which, practically speaking cannot be attained. In this sense it is not possible for us to obtain any substance completely free from impurities, and we must therefore be contented to carry the purification as far as possible—a task with which chemist and physicist are employed. A few striking examples may be noted in this field, and especially those in connection with the name of Stas. At first for the purpose of carrying out his atomic weight determinations there was demanded exceptionally pure substances, and it was naturally necessary for him to devise the means of obtaining them. Later he took up the experimental proof of the problem which had been suggested by Lockyer as to the composite nature of certain metals, and for this purpose Stas prepared with the greatest care a series of pure salts. For example, after eleven years' labor he succeeded in preparing a specimen of potassium chlorid, in which it was not possible to detect by any means the slightest trace of sodium. The investigations of Kohlrauch and Heydweiller may be mentioned here. They undertook the preparation of pure water in order to be able to determine its electrical conductivity with the greatest possible exactness. These investigators were obliged to carry out their work in glass vessels, and under such circumstances we can but be astounded that they succeeded in obtaining water so pure that a liter contained the exceedingly small quantity of a few thousandths of a milligram of foreign substance. More recently W. Spring has been engaged in this same problem of the purification of water, and has thrown new light upon it. He has found that in all liquids which have been purified by distillation (that is, according to the methods commonly in use up to this time) small particles are still present which may be detected by optical methods, and which in some circumstances can be eliminated by an electrolytic process.

Thus these new and more accurate methods furnish results which now in one direction and now in another can be considered more exact, although the attainment of the limit, as already mentioned, must be regarded as impossible. In other words, we are not in a position to absolutely exclude from a given space which is filled with one substance a large number of other substances. Nevertheless perhaps, in a single instance it has been possible. To touch upon this briefly, we must notice the problem which has been handled with remarkable accuracy by Baker, an Englishman. Baker has set for himself primarily the problem of the relations of gases to each other in conditions of the greatest possible freedom from moisture. In passing it may be stated that these gases were kept in fused glass tubes for months in contact with the best drying substances, for example phosphorus pentoxid, and thereby acquired in most cases very remarkable properties.

Substances which in other conditions react upon each other with the greatest energy were perfectly indifferent. Thus the dangerous phosphorus, which generally takes fire in the air at a temperature somewhat lower than that of the body, can be distilled in oxygen; and hydrochloric acid and ammonia gas can be mixed without indicating any reaction. How shall we reconcile these observations with our commonly accepted theories? Is there here an interval in the properties, and is this interval connected with a similar interval in the conditions; that is, have affinity and moisture here in fact become absolutely nil? It is indeed hardly necessary to assume that the affinity has become zero, for one can equally well account for the phenomena, if one assumes that the velocity of the reaction has diminished very greatly, as seems already to have been proved the case at very low temperatures and for a perfectly dry mixture of carbon monoxid and oxygen. Also against the assumption that in Baker's experiment the last molecule of water has been wholly removed may be cited the fact that the water which is contained in the metaphosphoric acid still possesses an extremely small vapor tension. Further, even if Baker's dried gases really undergo a sudden change in their chemical properties, it does not necessarily follow that at the same time a sudden change in the moisture shall be present. As a matter of fact, we know that the properties of matter often change in a very unexpected way when they are only in the vicinity of such a limiting condition. The electrical phenomena in tubes of high vacuum present a familiar example. From a theoretical standpoint the facts which have been mentioned, aside from the interest which they arouse from their strangeness, are also remarkable on another ground. This has reference to the different hypotheses which have been proposed as the cause of reactions. Among these we may note that of Armstrong, who assumes the presence of free atoms or ions and looks upon the conditions of reaction in gases, practically in a similar way to that demanded by the theory of Arrhenius and Ostwald for liquid electrolytes. By this the analogy which has been suggested between these two states of aggregation, and which at present dominates the thought in the province of inorganic chemistry, is rendered complete We may add to this that the remarkable observations, according to which gases under the influence of Röntgen and certain other rays become conductors just as if electrolytes, lead to the same conclusion. It shows us again in what close relationship the perfection of methods and of the experimental resources on the one side, and advancement in knowledge on the other, stand to each other. Experimental science and theory are a constant stimulus to each other and bring forth their fruit side by side.

And now I have come to the end of my proposed task. I have indeed spoken only from the standpoint of my own field; but I believe that the conclusions which are drawn from these considerations may be so far generalized that they appear of importance for the technologist also. The sciences on which his work rests are applied mathematics and applied natural science. The former can do its work wherever the latter has by experiment laid a foundation, and because thus in the improvement of methods and appliances results are being attained which are of increasing value, the technologist may take an interest, we may almost say an egotistic interest, in the successful development of the pure natural sciences. One thing further, of a more ethical nature may be suggested by the fundamental similarity of the problems in both departments. Just as we chemists labor to come as close as possible

to the absolutely pure substance, or to some numerical value (atomic weight and the like), in the same way the machine builder strives for the conveyance of energy with the least possible loss, and the engineer for the lightest possible carrier.

And if indeed, the complete solution of these problems lies beyond the scope of our powers, if from the side of nature the inexorable 'No' stands against us; nevertheless, we have in our hands in the increasing accuracy of our methods of work the true philosopher's stone, by means of which we can ever come nearer and nearer to our goal. Let us look upon the creation of new methods of experimentation and the improvement of the old methods in our practical science, as one of the most important duties for those who seek for progress and see in the development of our powers of reason the foremost task of the cultured mind.

FRIEDRICH EMICH.

GRAZ, HUNGARY.

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*CORRESPONDENCE OF C. S. RAFINESQUE AND PROFESSOR WM. WAGNER.*

IN hunting through the natural history material collected by the late Professor William Wagner in the Wagner Free Institute of Science, some fourteen years ago, I discovered several letters from the eccentric naturalist Rafinesque, together with a number of pamphlets written by him.

Professor Wagner had evidently taken up Rafinesque upon his return to Philadelphia from Kentucky with all the enthusiasm that a man interested in the development of the study of natural history must have for one who gave his whole time and all the money he could scrape together for the amassing of collections in every department of zoology and botany. It would appear from the context that Rafinesque had got into trouble (no unusual thing for him) and wished Professor Wagner to go on his note for the amount necessary to relieve him. This was promptly refused for the reasons given in Professor Wagner's letter, and Rafinesque writes to him on the 10th of April, 1840, as follows:

DEAR SIR:—I wish you will send me five dollars at y'r convenience for my 'Amenities of Nature' or at least One Dollar for the first Number that you have already had—that is the price. The value of Montford is $10. having 261 plates & with my notes $12. to 15; while Mantell is only worth $3.

I sell my works, my shells, my drawings and my services—I give them away sometimes to particular friends only, altho' I can hardly afford it.

Yours, &c,

C. S. RAFINESQUE.

Professor Wagner immediately replied on the 10th of April, 1840:

DEAR SIR:—Your note of this morning I found on my table on my return home at noon.

Your singular request to send you five dollars "at my convenience for your 'Amenities of Nature,' or one dollar for the one you say I have rec'd really surprises me. I now return to you unread, as my time has been otherwise much occupied that which you loaned me for my perusal and to which I never subscribed. If you have done perusing my copy of Mantell which, you informed me, you had read with interest & pleasure, you will please hand it to the bearer, as I wish to lend it to other of my friends. You inform me you sell your works, shells, drawings & services. I would beg leave to remark I have no occasion for any of them at present. You add "you give them away sometimes to particular friends only." I would add if you intend the remark for me you must know I never asked you for anything, neither have I ever received an atom of any of your property or effects, no not the most trifling, neither do I want them. I really regret my refusal yesterday to enter the requested security has produced an ebullition of feeling as your note indicates. I would have thought that your age and philosophy would have controlled your passions particularly after my explaining my reasons.

Yours, &c,

WM. WAGNER.

The reply from Rafinesque is dated April 12, 1840, and reads as follows:

MR. WILLIAM WAGNER.—The work of Mantell was delivered to your servant as you requested. I am used to disappointments—it was not an angry feeling but *sorrow* I experienced at your refusal;

*sorrow* that I had been mistaken in hoping I had acquired another learned friend. I had anticipated much pleasure from the study with you of the shells and fossils of y'r fine cabinet, as you tendered—you may now have that pleasure alone. I wish Conrad, Troost and others may be found willing to give you for nothing the use of their labors and discoveries, as I had proposed for my own; but I doubt it; Few are as liberal as I am. As you neither require my works, nor shells, nor fossils, nor labors *now*, I have wondered why you asked them before.

My time will thus be better employed perhaps in continuing my solitary labors. It is a pity that here naturalists will not be friends and labor jointly to increase knowledge. When you return from your intended travels we may resume joint studies, if you require it.

Respectfully yours,

C. S. Rafinesque.

On the 16th Professor Wagner writes:

Your note of the 12th was handed me this morning only. You still harp upon the disappointment you receed in my refusal to enter bail as you stated for your appearance only to prosecute an appeal which in reality was bail for debt, squire fees, court expenses, etc., in case of final defeat. If your boisterous manner and final departure without an ordinary adieu expresses sorrow (& what I considered anger) why you show your feelings very differently from anyone I ever saw. I expressly informed you I was retiring from business and this day we have advertised our stock for sale at auction and I have resolved that I would not contract any new liabilities, that I was closing everything and would avoid all new responsibilities. Any reasonable man would not have murmured at such an explanation. My article of copartnership independently of all other objections positively precludes my complying with your request. I regret that you should have thrown the obstruction in the way of our scientific intercourse and assure you that I was as much pleased with our friendly interchange of thoughts and opinions as you could possibly have been. You have caused the breach. Therefore it is for you to close it if you desire it. You again speak of giving for nothing your labor, your discoveries, etc. I never received any of your labors, or discoveries, or anything else. If you can show I have, send me a bill of it and I will pay your demands. The only transaction we have had was that I loaned you a book and you loaned me one. I cordially agree with you that any interruption of our joint studies by your extraordinary request is as disagreeable to me as it can be to you.

Respectfully yours,

The last letter comes from Rafinesque under date of the 17th of April, 1840.

Sir:—Y'r letter of yesterday did not require immediate answer, but having received two important letters from European geologists which under other circumstances would have been immediately shown to you, it may be proper to impart some of their contents. My Geological Fragments have been published by the first Geological Society of Europe. I am informed that American fossils (particularly of the oldest formations) are very scarce in European collections and wanted for sale and exchange. I am instructed to apply to you and others for specimens but all of mine are required. Muchinson (?) and a friend of mine are going to publish jointly the whole silurian system of Europe and all such American fossils of that age they can procure, therefore as you have stated you no longer want my fossils and have perhaps given up y'r idea of undertaking the American silurian system—I propose to send to Europe this year the whole of my American fossils amounting to thousands and of great value—of which it is proper you should be apprized in time. If you should go to Europe instead of the South and West and carry your fossils there, I will be able to inform you further. I shall no longer *harp* as you say on my disappointment I have merely to remark that as a candid man I prefer a direct refusal to pretext. That you may be undeceived ab't your apparent surmise, I must add that I don't owe one dollar to anybody, and pay all just demands. It was never stated that you received any of my labors and I don't send false bills to anyone. My herbarium was all around us at my office and you never asked to peep into it. My fossils and shells are in boxes as I cannot spend large sums like you to display them. They have been tendered for drawings only at y'r own request, a great favor you ought to know; but next year shall be in Europe where valued and paid for in the equivalents. As I have many duplicates if you will exchange them immediately with some of y'rs I have no objection—Price for price.

Respectfully y'rs,

C. F. Rafinesque.

These letters would seem to be almost childish but for the fact that Rafinesque had been for several years thoroughly eccentric in his actions and this was probably the beginning of the miserable end.

They were probably written when he lived on Race Street in a garret. If he died on September 18, 1840, as is stated by R. E.

Call in his 'Life and Writings of Rafinesque' these must have been written but five months before his decease and his quarrel with Professor Wagner probably ended his scientific associations in this City.

In looking up the date of his death I have been struck with the fact that Lippincott's Biographical Dictionary, Simpson's 'Lives of Eminent Philadelphians' and Appleton's Cyclopedia of American Biography quote the date of his death as September 18, 1842 and the National Cyclopedia of American Biography is the only authority that I can find for the year 1840, which is used by Call.

THOMAS L. MONTGOMERY.
WAGNER FREE INSTITUTE OF SCIENCE,
March 2, 1900.

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## *SOME OBSERVATIONS CONCERNING SPECIES AND SUBSPECIES.**

SOME few weeks ago I gave to this Society a brief general account of the investigations which the Fish Commission carried on at Lake Maxinkuckee during the past summer and fall.

At this time, I desire to speak briefly concerning two new fishes obtained in these investigations, and certain questions concerning species and subspecies which their study has suggested.

In the first place, permit me to repeat some of the statements regarding the lake and its small tributary streams.

Lake Maxinkuckee is located in the southwest corner of Marshall County, Indiana, on the Logansport and Terre Haute railroad, 32 miles north of Logansport, or 34 miles south of South Bend, Indiana. It is about 2.75 miles long, from north to south, 1.75 miles wide, and is quite regular in outline. This, like all the lakes of northern Indiana, is of glacial origin. Its greatest depth, so far as known, is 86 feet. The bottom is of compact sand and gravel near the shore, then a wide bed of marl, and soft mud in the deeper parts. There are only 1 or 2 short reaches near the shore where the bottom is soft. The water is relatively pure and clear. The bottom temperature in summer is 47° to 50° Fahr., while the surface gets as warm as 77° to 80°.

The lake is well supplied with aquatic vegetation; *Chara*, *Potamogeton*, *Myriophyllum*, *Ceratophyllum*, *Nitella*, *Vallisneria* and *Scirpus* being abundant. At least ten species of *Potamogeton* occur and two species of *Scirpus* are found. *Chara* is very abundant, great beds of it covering the bottom in many places from near shore out to a depth of 12 or 15 feet.

The catchment basin of the lake is small. There are no tributary streams except one very small brook at the south end; a somewhat larger one at the southeast corner, and three small ones upon the east and northeast sides. The total amount of inflow from these little creeks is but a few gallons per minute. They are all short, sluggish streams and do not vary greatly in size at any time. Perhaps the only ones deserving mention are (1) the one at the southeast corner which is popularly known as 'the inlet,' (2) one near the middle of the east side, and (3) one at the northeast corner flowing into Culver Bay, and which has come to be known as Culver Inlet. The stream on the east side has been called Aubeenaubee Creek, from the Pottowattomie chief of that name who at one time owned the land on the east of the lake. It was from this small creek that the specimens of the new species were obtained. Aubeenaubee Creek does not exceed 1.5 miles in length. It has its source in a small marsh, and is a sluggish stream flowing through a low, level meadow or prairie region. It is about 4 feet wide and averages only 3 to 6 inches deep, with deeper holes at intervals. Through most of its

* Read before the Washington Biological Society, Jan. 26, 1900.

length the stream is overhung by bushes and briars, and is full of sticks and brush. The bed and banks are of black mud with a mixture of sand. In some places the ground is quite boggy. The midday summer temperature of the water in this stream is about 72°. The species of fishes found in this stream are almost wholly different from those found in the lake proper, a fact illustrating clearly the importance of even slight differences in geographic location if accompanied by stable environmental differences. The principal fishes occurring in this creek are *Semotilus atromacalatus*, *Campostoma anomalum*, *Umbra limi*, *Lucius vermiculatus*, *Notropis cornutus*, and young *Micropterus salmoides*. Crawfishes were abundant.

The two new fishes discovered are both darters, one belonging to the genus *Hadropterus* and the other to the genus *Etheostoma*.

I may say, in passing, that the darters are members of the Percidæ or Perch family, to which belong the walleyed pike, the Sauger and the Yellow perch. Sixteen genera and 85 species of darters are recognized. They are all small, active fishes, usually brilliant in coloration and have much the same position among fishes that the warblers have among birds.

Both of the new darters obtained at Lake Maxinkuckee were found in Aubeenaubee Creek and nowhere else.

The nearest relative of the species of *Hardopterus* is *H. scierus*, which, though not known to occur in Lake Maxinkuckee, is found in Yellow River of the Kankakee drainage, only a few miles north, and also in Tippecanoe River five miles south of the lake. The form found in the creek is well set off from its nearest relative and is described as a species.

The other darter, described as new, is evidently derived from *E. iowæ*, which is found, not only in many of the streams of western Indiana, but also in Lake Maxinkuckee in some abundance. It is, however, not known to occur in Aubeenaubee Creek.

*Etheostoma iowæ*, in extending its range from its original center of distribution, in all probability, found its way into Lake Maxinkuckee from the Tippecanoe River. Having once become established in the lake, individuals sooner or later began entering its tributary streams. Among the individuals entering Aubeenaubee Creek there were some that, finding the conditions easy, remained and bred there, and thus a creek colony was established. It is altogether probable that for some, possibly many years, individuals from the colony would occasionally return to the lake and interbreed with individuals that had never left the lake. And the reverse would also take place: individuals from the lake would probably continue for many years to invade the domain of the creek colony and interbreed with its members. Under conditions such as these, the members of the colony going farthest toward the head of the creek were probably the ones which soonest became free from the influence of the lake and, breeding only among themselves, were modified most rapidly by the new environment. In time they became so well differentiated as to render them readily distinguishable from the parent form in the lake. During the continuance of the conditions mentioned, however, the migration and countermigration between the lake and the stream, there would be found in the lower part of the stream and in the lake about its mouth, the progeny of the individuals from the lake and creek which had interbred. These would possess characters more or less intermediate between the parent species (*E. iowæ*) and the derived form inhabiting the creek. So long as these intermediate forms continued to exist, the form found in the creek would be only an incipient species. As an incipient species it would

be a subspecies of *E. iowæ*, and would receive a trinominal name.

But if, in the course of time, invasions of one habitat by individuals from the other should cease, then the intergrading forms would, through interbreeding with the extreme forms, be gradually absorbed by them and finally disappear altogether. In the creek would then be found a form differing clearly and constantly from the lake form and without any connecting forms. Under these circumstances the form in the creek, as well as that in the lake, must rank as a distinct species.

This is the present condition, so far as our investigations have enabled us to determine. There is no difficulty in distinguishing individuals taken in the lake from those found in the creek, and neither form seems to invade the habitat of the other. Large collections were made, not only of the fishes inhabiting the lake, but also of those in the creek. The latter was carefully seined twice, from its source to its mouth, and not a single example of *E. iowæ* or any form showing intergradation was seen. Similarly careful investigations were made in the lake without discovering any individuals of the creek form or any showing intergradation. Whether further collecting will discover connecting forms cannot, of course, be stated. The small size of the creek and of the lake, and their close geographic relation, render it almost certain that individuals of the one form would occasionally invade the habitat of the other, and *vice versa*. While the environment of the creek is markedly different from that of the lake, it is improbable that a change from one to the other would prove disastrous to the individuals concerned. Some of such individuals would, it seems, be able to survive, and some would probably interbreed with individuals of the other form whose habitat they had invaded. This was, quite likely, the condition in the beginning, and the creek form, so long as it remained connected with the parent species by the intergrading forms resulting from such interbreedings, would be a subspecies of the parent species. But, as already stated, no such connecting forms have yet been found and the form inhabiting the creek is a distinct species.

There is one other possible condition worth considering. Let us suppose that, after the creek colony had become well established, and for many generations had not intermingled in any way with the parent species in the lake, the habits of one or the other, or both, should change somewhat and that they should again begin to invade each other's habitat and to interbreed. The result of this interbreeding would be the appearance of individuals possessing morphological characters more or less intermediate between the lake and the creek forms. In other words, individuals would be found showing that the two forms intergrade and placing them again in the relation of species and subspecies. If we could *know* this to have been their history, however, we should certainly not place them in the relation of species and subspecies. We should regard them as two distinct species, and the individuals which seem to show intergradation we would call hydrids, which they really are. But we can rarely, if ever, *know* that such has been the history. So long as intergradations are found connecting the two forms, the one last discovered must be regarded as a subspecies of the other. In the present case, however, no intergradations seem to exist, and the relation is that of two distinct species. While the occurrence in nature of hybrids is doubtless very unusual, such a condition as the one supposed is certainly not improbable.

And this suggests a further consideration of subspecies. An examination of the descriptions of forms which have been published as subspecies does not show that the

describers have all been governed by the same principles, or that all who have described subspecies have had very well-defined ideas as to what a subspecies really is. I am sure that I myself have given trinominal names to new forms with rather hazy ideas upon the relation of species and subspecies.

The present practice of most systematists in this country seems to be to regard any two given forms as distinct species, unless they are known to possess morphological characters which intergrade. If characters showing intergradation are present, the one later described is regarded as a subspecies of the other. The intergrading may be of two kinds of categories:

1. It may be associated with the known joining of the two respective habitats. In this case the individuals possessing the intermediate characters would come from the region where the two forms, or the habitats of the two forms, join or overlap. If *E. iowæ* were known to intergrade with the *Etheostoma* of Aubeenaubee Creek, the connecting forms, if of this category, would be found in the mouth of the creek, or in the lake near the mouth of the creek. This, it seems to me, would be a good example of what we mean by a subspecies.

2. In the other case, the two habitats do not join, but an examination of a series of specimens from each will show an intergradation of characters. Though the sum total of the characters is different, individuals will be found in one series which possess, in varying degree, all the characters shown by those of the other. The individuals showing the intergradation come from the same localities from which have been obtained the typical individuals. They do not come from intervening localities because the habitats do not join.

Is it correct to regard these two forms as sustaining the relation of species and subspecies?

Trinominal names have, in many instances, been given because the differences separating the form under consideration from some previously-known form are slight. But now, the almost uniform practice seems to be to regard constant differences, however slight, in the absence of known intergrading forms, as of specific value; and differences, however great, if known to intergrade, to be only of subspecific value.

If this view be correct, there are many trinominals in current faunal and floral lists which are there without sufficient warrant. In the latest systematic work on American fishes 3255 species and subspecies are recognized. Of these, 125 are ranked as subspecies. But an examination of the facts regarding each shows that very few of them should stand as subspecies, but as species. They have, in most cases, been called subspecies simply because they differed but slightly from the most closely related species. I doubt if intergradation is *known* to exist in 25 per cent. of the cases.

I have been told that many of the trinominals in current use in ornithology rest upon the same insufficient evidence.

It is the practice of some, I believe, to describe as subspecies forms which, though not *known* at the time to intergrade, will in all probability, be found to do so. The describer's knowledge of the group to which they belong, the principles of geographic distribution, and the geography of the country in which they are found, justify him in anticipating the evidence of actual intergradation.

Personally, I doubt if this is the best course to pursue. Would it not be better, either to wait until the evidence is in hand, or describe the new form as a species?

We sometimes hear the remark that systematists often go too far, and describe as new species or subspecies forms which differ but slightly from known forms; that they give

specific or subspecific value to differences which are due merely to some slight difference in environment. This, it seems to me, misses the whole point. What produces species and subspecies, anyway, except slight differences in environment, together with greater or less geographic isolation? And when we see these differences why should we refuse to admit their existence or their meaning?

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U. S. COMMISSION OF FISH AND FISHERIES.

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### *BREATHING OXYGEN.*

THE experiments here described were carried out during the course of an investigation to determine the quantity of carbon dioxide exhaled from the lungs of different persons under stated conditions.

The method of procedure was as follows: (1) Ordinary air was inhaled through the nostrils and exhaled through the mouth (the nostrils being closed) into an inverted receiver filled with water. The quantity of carbon dioxide in the exhaled gases was determined in the usual manner. (2) A mixture of air and oxygen containing 26.4 % of oxygen was inhaled and exhaled as in (1). (3) Pure oxygen was employed and the experiments conducted as in (1) and (2).

The breathing experiments were made by three different persons, A, B, and C, under conditions as nearly indentical as possible.

The following results were obtained:

| A | | B | | C | | |
|---|---|---|---|---|---|---|
| Exp. | $CO_2$ | Exp. | $CO_2$ | Exp. | $CO_2$ | |
| 1 | 3.8 | 10 | 3.6 | 19 | 3.8 | Ordinary air. |
| 2 | 5.2 | 11 | 4.4 | 20 | 5.1 | |
| 3 | 5.6 | 12 | 4.6 | 21 | 5.8 | |
| 4 | 4.0 | 13 | 4.0 | 22 | 4.0 | Air and oxygen. |
| 5 | 5.6 | 14 | 5.2 | 23 | 5.4 | |
| 6 | — | 15 | 5.6 | 24 | 5.6 | |
| 7 | 4.2 | 16 | 4.8 | 25 | 4.4 | Pure oxygen. |
| 8 | 5.8 | 17 | 5.6 | 26 | 5.8 | |
| 9 | 6.2 | 18 | 6.2 | 27 | 6.4 | |

The figures given express percentages by volume; they are lower than those that would be obtained if the exhaled gases were collected over water saturated with carbon dioxide. The object of the experiments was to get relative rather than absolute values. In experiments 1, 4, 7, 10, 13, 16, 19, 22 and 25, the gas (air, mixture of air and oxygen, or oxygen) was inhaled for five seconds and then exhaled for five seconds.

In experiments 2, 5, 8, 11, 14, 17, 20, 23 and 26 the lungs were inflated as fully as possible with the gas, which was retained *fifteen* seconds and then exhaled.

In the other experiments, 3, 6, 9, 12, 15, 18, 21, 24 and 27, the lungs were fully inflated and the gas retained *thirty* seconds before exhalation.

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### *THE SOCIETY OF AMERICAN BACTERIOLOGISTS.*

THE following are abstracts of papers read at the first meeting of the Society of American Bacteriologists, held at New Haven, December 27th to 29th.

*Natural varieties of Bacteria:* PROFESSOR H. W. CONN.

Professor Conn exhibited some cultures of a highly variable Micrococcus which he had isolated many times from milk. Its color ranged all the way from a snow white to a deep orange, and in power of liquefying gelatin it ranged from a form that liquefied with great rapidity to one that had apparently no liquefying power. All these varieties, with numerous intermediate stages, have been found in nature and are not the result of cultivation. Professor Conn showed, however, what a great change can apparently be produced in the character of a species, by a simple process of selection. Starting with a pure culture of this organism, he was able to produce from it a white and an orange culture, by simply replating many times, and selecting the whitest color, on the one hand, and the

yellowest, on the other. At the same time, by selecting the colony which liquefied most rapidly and the one which liquefied most slowly, he was able to obtain from the same original culture, rapidly liquefying cultures, and those with hardly any liquefying power. He raised the question whether many of the changes which had been described as due to changed environment, might not really be due to such unconscious differentiated selection.

*The significance of varieties among Pathogenic Bacteria:* Professor Theobald Smith.

In the study of bacteria, morphological details are of but little value in differentiating and classifying forms because of their minuteness. Processes of conjugation and other sexual phenomena, such as are found among Protozoa, are unknown.

The problem of variation may be discussed under these heads:

1. The actual existence of bacteria whose relationship is conceded, although they manifest slight differences among themselves.

2. The artificial modification of bacteria by experiment.

3. The evolution of parasitic from saprophytic forms.

In the investigation of problems of this character it is necessary to study, not only the effect of related bacteria on the same host, but that of the same bacteria on different hosts. Our investigations should be both experimental and comparative.

(The variations occurring in the group of bacteria of which the rabbit septicæmia bacillus is the type, and those occurring in the pathogenic derivatives of the colon group, were discussed and illustrated. Variations among tubercle bacilli, in form and virulence, and among diphtheria bacilli, in the production of toxin, were also referred to.)

The modifications which bacteria undergo, during passages through animals, vary in degree with the species and group under observation; with some, such as the rabbit septicæmia bacilli, streptococci, and pneumococcii increase in virulence is easily attained; with the colon group this is much more difficult. The degree of change that can be impressed upon any bacteria probably depends largely on the specific structure of the organism.

The evolution of parasitic from saprophytic forms is a very slow and gradual process, whose mechanism may have differed with different species. Special advantages which a certain environment may offer for frequent passages through susceptible species may give certain saprophytes an impulse towards a parasitic existence. In any case, such saprophytes probably possess from the outset certain fighting characters, such as the power to produce toxins which enable the few among the myriads of forms, eventually, to become disease germs. (Published in the *Journal of the Boston Society of Medical Sciences*, January 16, 1900.)

*Methods employed in the teaching of Bacteriology:* Professor H. C. Ernst.

In response to a circular letter sent to the Institutions of Learning that teach medicine, as given in the 1899 volume of *Minerva*, there were returned ninety-eight replies. The letter asked for information as to whether Bacteriology was taught as a separate branch—in case it was not, in what department it was included—how many instructors were engaged in teaching this subject—the hours required—and other details of interest. It was found that forty-two institutions give instruction in Bacteriology as a separate department—twenty-six give separate courses, in connection with the department of Hygiene, and thirty-seven in connection with the department of Pathology, or Pathological Anatomy.

The increase in the numbers of teachers

of bacteriology in connection with medicine was noted, over the condition as found in the first volume of *Minerva* (1892).

(The full details of this investigation will be found in the *Journal of the Boston Society of the Medical Sciences*, Vol. IV., p. 67 et seq.)

*On the changes of opinion in England in favor of bacterial purification of sewage:* PROFESSOR L. P. KINNICUTT.

Professor Kinnicutt described recent experiments conducted in England which are producing a change in opinion as to the best method of treating sewage. Whereas, hitherto the chemical method of treatment has been commonly used, the belief is now rapidly gaining ground that the purification of sewage by bacterial growth offers the cheapest and most efficient method of purifying it so that it may be discharged into rivers without polluting them.

*Recent work on sewage purification involving bacteria:* H. W. CLARK.

The paper brought out clearly the fact that the benefit derived from preliminary anærobic bacterial action upon sewage before filtration has been recognized at the Lawrence Experiment Station for several years, and calls attention to statements made, and investigations upon this point recorded in the reports of the Station for 1895 and 1896 (see report of Massachusetts State Board of Health for these years). It gives credit to Cameron for first practical use of anaërobic action with his septic tank at Exeter, England. Results of investigations upon production and purification of septic sewage at the Lawrence Experiment Station during 1897 and 1898 were given, with a comparison of intermittent sand filters and bacterial or contact filters. Rates of filtration of septic sewage, equal to 300,000 gallons per acre, have been attained with sand filters at Lawrence, and of 800,000 with contact filters, with satisfactory purification. Investigations at Lawrence during 1898 have shown that open septic tanks are as successful as those made air-tight, owing to the scum of bacterial growths, fat, etc., formed over the surface of the sewage. Some experiments made at the Station seem to indicate strongly that anaërobic action may be carried to such a point that the resulting sewage is very difficult to purify.

The paper also gave the result of an experiment in which sewage during 1898 was passed through a filter of broken stone ten feet deep, at the rate of one million nine hundred thousand (1,900,000) gallons per acre daily, with very satisfactory results, nitrification being active, purification satisfactory, and the rate of filtration more than twice as great as ever before attained at Lawrence with crude sewage.

*The significance of the appearance of B. Coli communis in filtered water:* H. W. CLARK and S. D. M. GAGE. (Read by H. W. Clark.)

The purification of polluted waters by sand filtration has been studied at the Lawrence Experiment Station for the past thirteen years. Up to the beginning of 1897 the efficiency of the filters in removing bacteria was ascertained by determinations of the actual number of bacteria in the water applied to the filters and the effluents from them. For the past three years determinations of the number of *B. coli communis* in the applied water and effluents have been made. Especially has the efficiency of the Lawrence City Filter in removing this germ from the Merrimac River water been carefully followed. This was done, as it was believed that the significance of the appearance of the germ in the filtered water could be determined because of the opportunity presented of studying its appearance in connection with the occurrence or non-occurrence of cases of

typhoid fever in the city of 55,000 inhabitants using this filtered water.

This city filter was built in 1893, and, while the death rate from typhoid fever in Lawrence for a number of years before its construction averaged about 12 per 10,000 inhabitants; the first year after construction the rate was 4.75 per 10,000 inhabitants, and this was followed by a steady yearly decrease to 1.39 in 1898. During this period there was no unusual disturbance of the sand filter bed, and its bacterial efficiency was good.

In the fall of 1898 it was necessary to relay some of the underdrains of the filter, and some of the sand beds were very much disturbed. When the sand was replaced and water was again passed through the filter the entire effluent was pumped to the reservoir and used in the city. Following the conclusion of this work, *B. coli communis* was found in 1 c.c. of 72 per cent. of the samples of the effluent of the filter examined during December; 54 per cent. of those examined during January; 62 per cent. of those examined during February; and 8 per cent. of those examined during March. The bacterial efficiency of the filter, or percentage removal of total numbers of bacteria in the applied water, was 92.20 per cent. from December 10th to 31st; 98.31 per cent. in January; 98.17 per cent. in February; and 99.89 per cent. in March.

During the period from the end of the disturbance of the filter in December until the end of the month there were twelve cases of typhoid fever reported in the city; during January, 59 cases; during February, 12 cases; but in March, when *B. coli communis* had practically disappeared from the effluent of the filter, there were but 9 cases, and these during the first portion of the month; that is, during the months of December, January and February there was an epidemic of typhoid fever in Lawrence. During this period, *B. coli* was present in 1 c.c. of samples of effluent of the filter examined to the extent denoted by the figures given. When it failed to be found in 1 c.c. the epidemic had ceased. When 100 c.c. of the effluent were examined, *B. coli* was found more frequently, but the figures and facts in regard to the epidemic seem to show that, when filtering a river water as polluted as that of the Merrimac, it is safe to assume that, when *coli* is found only infrequently in 1 c.c. of the effluent, the typhoid germs, necessarily fewer in number, and more easily removed by the filter, have been eliminated from the water. The death rate of the city from typhoid fever in 1899 was 3.00 per 10,000 inhabitants.

*On the detection of bacillus Coli communis in water:* Professor E. O. Jordan.

The direct application of the fermentation tube method to greatly polluted waters sometimes meets with a serious difficulty. This is the fact that other gas-forming species (and perhaps some non-producers of gas) overgrow *B. coli* and obscure or falsify the typical reaction. This appears to happen at least with some river waters more commonly than has generally been supposed, even when extreme dilutions are employed. One species that interferes often with the growth of *B. coli* is a variety of *B. cloacæ*, and when mixtures of pure cultures of this microbe and of *B. coli* are introduced together into fermentation tubes, the former frequently gains the upper hand.

A method that has given promise of overcoming this difficulty, and some others, is the following. The desired quantity of water is incubated in acid carbol broth, 1. c.c. of the required dilution being added to 5 c.c. of broth made 5 to 5.5 acid on Fuller's scale, and containing carbolic acid in the proportion of 1–1000. After inoculation at 38°–40° for 12 to 18 hours, platings are made in litmus lactose agar, and colo-

nies reddening this medium are tested for coagulation of milk, indol production, liquefaction of gelatin, and gas production in glucose broth. A recent comparison of the two methods has given the following results:

| | Positive results. | Negative results. |
|---|---|---|
| Fermentation tube direct | 21 | 34 |
| Acid carbol broth | 26 | 24 |

Although the number of experiments is small, the results indicate the distinctly greater delicacy of the latter method when applied to the waters used in these tests. The application of this method is interfered with, to some extent, by the same species that complicates the result in the fermentation tube, but the use of the litmus lactose agar facilitates the separation of *B. coli*, especially if the plate be examined within 24 hours after the sowing.

*Demonstration of Actinomycosis and the Causative Fungus:* PROFESSOR H. C. ERNST.

A specimen of very marked affection of the udder with the Actinomyces fungus was reported. Attention was called to the comparative rarity of the disease in this marked form, and the fact that the text-books say but little about it as a possible source of infection. A number of microscopic preparations were demonstrated. (This case is also to be published in the *Journal of the Boston Society of the Medical Sciences*, Volume IV.)

*A comparison of B. Coli communis from different species of animals:* V. A. MOORE and F. R. WRIGHT. (Read by F. R. Wright.)

Different forms of *Bacillus coli communis*, from contaminated water supplies and variations of the same organism in tissues of different species of animals, have led to this investigation to determine the range of variation of *Bacillus coli communis* in (1) different species of animals, and (2) in the same species, always under supposedly healthy conditions. As the work was not begun until late in the summer, this paper is to be regarded only as a report of progress.

The methods which were followed were:

(1) To take a loop-full of the mucus from the large and small intestines and inoculate a series of gelatin plates from each.

(2) To make sub-cultures from six typical spreading colonies which appear the same.

(3) To replate from these sub-cultures, to make sure of no contamination.

(4) From the second series of plates to make sub-cultures in the special media.

(5) To determine the pathogenesis by inoculating such experimental animals as the rabbit and guinea pig.

Thus far the results have shown that the organisms found in the horse, the dog, the cow, the sheep, and the hen, are more numerous in the large than in the small intestine.

The number of colonies from the same part of the intestine of the same species varies much, *e. g.*, in the large intestine of the horse, in some cases the colonies have been too numerous to count; again, there have been four or five hundred, and again, no more than a dozen. Where the number of *colon bacillis* was greatest, other species were few; where they were few, either a fungus or a micrococcus predominated in numbers. The most marked variations in the organism from the different species have been in the changes which they produced in milk, and in the various sugars and in their pathogenesis. The range of variation of the bacillus from the same species of animals has been found to be narrow.

*The invasion of the Udder by Bacteria:* ARCHIBALD R. WARD.

The extent to which lactiferous ducts of the cow's udder are invaded by bacteria, was determined by means of bacteriological

examinations of the udders of nineteen freshly slaughtered milch cows. Owing to the prohibitive expense of studying the udders of sound cows, it was deemed expedient to use those of cows slaughtered after condemnation by the tuberculin test. So far as possible, the udders of only slightly diseased cows were used. Samples of the fore milk were taken, and before slaughtering, the udder was milked as thoroughly as possible. The udder was removed from the carcass immediately after death and taken to a sheltered spot, for the bacterial examination. In each quarter in successson, a flamed knife was used to make an incision extending from the dorsal to the ventral region of the gland, and of such depth as to expose the tissue in the vicinity of its vertical axis. Bits of the glandular tissue were transferred with aseptic precautions to tubes of gelatin, and properly labeled to show the region from which the culture was made. After returning to the laboratory, the gelatin was liquefied at a gentle heat and poured in Petri dishes. By comparing the colonies appearing on the plates after several days, with those in cultures made from fore milk, it was possible to show that the same organism may occur in the fore milk in all parts of the udder.

The evidence appears to warrant a modification of the statements concerning the place at which milk first becomes contaminated by micro-organisms.

The writer concludes that, while milk is sterile when secreted, it may immediately become contaminated by the bacteria which normally inhabit the lactiferous ducts of the udder. (Published in Bulletin 178, Cornell University Agriculture Exper't Station.)

*Exhibition of cultures and stained specimens of plague bacillus from two cases of Bubonic plague admitted to New York harbor, November, 1899:* Wm. Hallock Park, M. D. Three slides were shown. The first was from a twenty-four-hour agar culture showing, among rather short thick bacilli, peculiar long thick thread forms. The second was from a twenty-four-hour bouillon culture showing short almost coccus forms in chains. The third was from the spleen of guinea pigs dying of septicæma, showing characteristic darker staining of the ends of the bacilli. Cultures were also shown on agar and gelatin. These cultures were of especial interest in that they were obtained from two persons, the captain and the cook, who arrived on a steamer from Santos, Brazil, in December, 1899, where the plague was prevalent. The two men when they arrived showed simply a large bubo in the lower inguinal glands. The temperature was nearly normal, and they did not feel ill. They had been sick about eleven days. They obtained the infection from a companion who had died and whom they nursed. Pus was removed from these bubos with a hypodermic needle. The pus from both cases contained the bubonic bacilli although in small numbers either living or dead. In culture they grew exactly like two other cultures which Dr. E. H. Wilson had obtained from India. Their violence was slightly greater than Dr. Wilson's cultures.

*Some suggestions on the study of systematic bacteriology:* Fred'k D. Chester.

Attention is called to a work now in progress in the arrangement of the better known species of bacteria. Certain typical forms or species of bacteria exist. These latter present certain definite morphologic, biologic, cultural, and perhaps pathogenic characters, which establish the types, independent of minor variations.

The most marked of these types become the centers of groups, around which are gathered related species and varieties.

Migula's system is followed as the basis or generic classification.

Tables were shown, giving arrangements of the bacteria in groups.

The necessity of some system of terminology for use in descriptive bacteriology was urged, and a table of definite terms presented. The question of nomenclature of species was discussed. Little or no regard has, in many instances, been paid by bacteriologists to the most ordinary rules of botanic nomenclature. This and the lack of knowledge concerning the synonomy of species has led to improper naming.

This was illustrated by a number of examples.

*A new pathogenic fungus—the sporothrix of Schenck:* PROFESSOR LUDWIG HEKTOEN. (Read by Dr. Jordan.)

Schenck has described a case of subcutaneous, refractory abscesses, caused by a fungus which Erwin F. Smith tentatively assigns to the genus *Sporotrichum*.

In the case of a boy, five years old, under the care of Dr. Perkins of Shenandoah, Sava., an identical fungus was found to produce similar, refractory lesions as those described by Schenck; the process started in an abrasion of the left index finger, caused by a blow with a hammer, and during the next two to three months over twenty-five abscesses appeared under the skin and forearm. Ultimately, recovery took place.

The fungus was obtained in pure culture on two different occasions. It grows well in ordinary media, forming in the older agar cultures brownish, wrinkled and folded layers. Gelatin is slowly liquefied. Ærobic. Thermal death point about 60° C. It has a separate branching mycelium; clusters of five or six spores appear around the ends of the branches and single spores develop along their sides. The spores are ovate or apiculate, from three to five mikrons in their longest diameter. Grams stain positive.

It produces chronic suppuration in the skin of mice and extensive ulcers; small, chronic abscesses may develop in the abdominal lymph glands after subcutaneous injection. In white rats intra-abdominal injection is followed by the development of numerous nodules enclosing small abscesses; the pus is thick and viscid, and contains oval and oblong gram-staining bodies in large numbers, but no thread. Pure cultures of the fungus are readily obtainable from lesions both in mice and rats.

Rabbits, guinea pigs, dogs and pigeons are immune. In guinea pigs and dogs, small subcutaneous abscesses sometimes form after injection under the skin.

*The importance of bacterial tests in the sanitary supervision of milk supplies:* MARSHALL O. LEIGHTON.

The investigations taken as a basis for this paper were made during the three years ending June, 1899, under the authority of the Board of Health of Montclair, N. J. Seventeen dairies were included in the report, the bacterial tests in each being confined to the determination of 'numbers per cubic centimeter.'

The average results for each dairy during the whole term divided themselves into three classes: First, those dairies having an average below 15,000; second, those between 40,000 and 70,000, and third, those above 180,000.

Comparing the foregoing results with the dairies themselves, as shown by stereopticon views of each, it was found that the dairies in class No. 1 were of the most improved type, in which the utmost cleanliness prevailed. Representing class No. 2, poorly equipped dairies were shown, in which the owners plainly endeavored to do their utmost with the crude means at hand to produce a pure product, but were unable to provide proper sanitary appliances to aid them; while class No. 3 represented those

dairies in which neither good equipment nor good intentions prevailed, but in which ignorance and indifference combined to produce poor dairies and unwholesome supplies. The comparison between the results of the determinations and the sanitary condition of the dairies was plainly marked in the photographic plates thrown upon the screen.

The practical importance of such an investigation was demonstrated in the publication of each year's results in the annual reports. The public have given them serious consideration and, in consequence, no less than a dozen unworthy dairymen have found their business unprofitable. In addition to this, several dairies have undergone a complete change in construction and in methods of production, and the supply as a whole had been raised to a high standard of purity.

*Notes on the effect of blood serum from tuberculous animals and men on the tubercle bacillus when mixed with it in the culture tube and hanging drop:* Dr. W. H. Park.

The serum was obtained through blisters from twenty-four persons, twelve having tuberculosis, and twelve not having any sign of the disease. The tubercle bacilli from a recent culture were ground up and a fine watery emulsion made. To this emulsion, divided into separate tubes, was added the serum from the different cases, to an amount such that in each case a 10 per cent. solution of serum resulted. Although in some the film forming on the slanted tubes was more tenacious than in others, no difference on the whole was seen between the dilution of serum from tubercular cases and that from non-tubercular ones. The result on the whole did not seem to offer much practical help.

*On the bacteriology of canned goods, with a detailed account of bacteria detected in sour corn:* S. C. Prescott.

The paper described some investigations upon the bacteria present in preserved cans of corn which had become spoiled and 'swelled.' The cause of the trouble was found to be the presence of certain species of bacilli which resisted the temperature used in canning the corn. The same bacilli were found upon the fresh corn and husks.

*Experimental and statistical studies on the influence of cold upon the bacillus of typhoid fever, and its distribution:* W. T. Sedgwick and C. E. A. Winslow. (Read by Mr. Winslow.)

A review of the literature on the subject of ice-supply and the public health shows that, while pollution of ice-ponds appears to have caused intestinal disturbance, no epidemic of typhoid fever has been satisfactorily traced to such a source. While it is known that cultures of the typhoid fever germ are not sterilized, the important question of the quantitative reduction of this species by freezing has been studied in only two limited investigations. The authors have, therefore, frozen large numbers of tubes of water inoculated with four different races of the typhoid bacillus, and determined the reduction after various periods. The results, twenty tubes being averaged for each period, show a rapid reduction in the first hour in freezing, varying from 30 per cent. in one culture to 60 per cent. in another; the reduction then proceeds approximately with the time of freezing, reaching a constant value of over 99 per cent. in two weeks. The last two or three germs per thousand appear to be very resistant, some remaining after twelve weeks of freezing. The four races used show constant individual differences in their susceptibility to cold. Alternate freezing and thawing was tested and found only slightly more destructive than continuous freezing. The destruction of the germ in cool, but

unfrozen water, followed the same laws, actual freezing causing only a slightly greater reduction than a temperature just above the freezing point. Finally, a few experiments on the formation of ice on a free surface showed that 90 per cent. of the germs present were excluded from the ice by physical processes. The authors conclude that the danger of typhoid infection from the small fraction of weakened germs remaining in natural ice is probably not a serious one, and that the results of their experiments are in harmony with the facts of experience.

H. W. CONN,
*Secretary.*

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## SCIENTIFIC BOOKS.

*Psychology and Life.* By HUGO MÜNSTERBERG. Boston, Houghton, Mifflin & Co. Pp. xi+286.

Professor Münsterberg has here gathered together a number of essays, and has given to the collection the title of the first of the papers. The others are discussions of the relation of Psychology to Physiology, Education, Art, History and 'Psychical Research,' respectively. The chapters thus have a common starting point in Psychology from which they veer off in different directions. The author's special comments in these many fields it is impossible to reproduce here even in outline; we must confine ourselves to the more general doctrine presented in the work.

The book is in many ways an exposition, or at least the hint, of a philosophy; and to deal with it adequately would take one inevitably into deep water. With his main contention that Psychology is but a partial way of dealing with the mind, the present writer feels entire sympathy. It is important to have it put strongly by a psychologist that when we shall have catalogued all the facts of our mental life and have discovered their causal order—which is the purpose of psychology—there still remain the larger questions which have to do with the value and meaning of these occurrences. Psychology, like any natural science, is concerned merely with the facts; its aim is to describe and explain things; and to this end leaves out of account the all-important problem of what our consciousness signifies or what its ideals should be. The things we perceive, he is fond of saying, merely 'exist' but are not 'real'. For this reason the real mental life—the life of will, of action, of valuation, of ideals—lies outside the province of psychology, which is ever busy with the beggarly elements of the mental life and never takes up the problems that interest us as active and moral beings—questions of deeper truth, of beauty, of conscience and religion. The scientific spirit is consequently something which stands in contrast with real life; it is no substitute for the moral and religious spirit.

At the same time Professor Münsterberg somewhat clouds this correct perception of his by putting the antithesis between facts and values too strongly. At times it looks almost as if each could get along without the other; as if a great gulf were fixed between them, so that the realm of ideas appears in almost Platonic isolation from the world of sense-perception. The 'world of values' and the 'world of facts' are of course not two worlds, but rather different ways of considering the self-same world. In Kantian phrase, we might say that facts without values are blind, while values without facts are empty. Professor Münsterberg shows, at least in one passage, that he himself takes this view; but a certain love of contrast and antithesis, too often makes him put the matter otherwise.

And in his endeavor to show the insufficiency of the psychological standpoint, the author really does injustice to psychology. He holds that psychology does, and must 'transform' the facts for purposes of explanation; and explanation, he believes, is possible only when we can restate the facts in terms of atoms or something else equally elementary. In psychology, consequently, everything must, by hook or crook, be analyzed into *sensations*, since these are the mental elements which correspond to the atoms of the physical world. Even when we distinctly know that the real mental process —an idea, an emotion, or act of will—is *not* completely described when we have enumerated the sensations that compose it, nevertheless (according to the author) the psychologist is by the logic of the situation forced to shut his eyes

to anything but these sensations and their laws. He must at least make believe that the act of will, for instance, is composed merely of sensations chiefly from the muscles, because only thereby is 'explanation' possible. In psychology, consequently, the truth is inevitably concealed, and some complex of sensations is substituted for the real mental process which we are to explain.

Few psychologists, I feel sure, would admit that this is a correct account of the psychological method. It sounds almost like a veiled *apologia* for some of the theories of both Professor Münsterberg and Professor James. They have each in their own way attempted to convince the world that certain 'complexes of sensations' were the whole truth in an act of will or an emotion; and the world has in the main steadily refused to be convinced. But now we are, as it were, called into the private office, and are told: "Of course, gentlemen, the complexes of sensations really are *not* the will or the emotion, but that is what we have to say they are if we are to be faithful to psychology."

But if in actually experiencing volition or emotion we clearly see that it is not a mere group of sensations, why should we be called upon gravely to declare in our psychologies the opposite? There is nothing in the rules of psychology to prevent our saying all the while that we are talking about the *sensations* characteristic of will or of emotion or of judgment—a mere part of the full process in consciousness. And if we can see, for instance, that a judgment has features additional to the mere sensations of muscular flexion or extension, I see no reason why, as psychologists, we should say, resignedly, that these other features are indescribable and beyond the pale of science. Quite apart from the question of values or of ideals, the experience itself reveals peculiarities of form that are quite definite and intelligible and communicable—has subject and predicate and the affirmative or negative connection, all of which are absent when the same sensations appear in a merely associative or temporal connection. Professor Münsterberg gives no sufficient reason why psychologists should hold that sensations are the only things in a mental process that are definite and describable and capable of helping to explain the process. As well might the physicist say that in his realm the bare atoms are all that he can take account of; when, in fact, time and distance are most necessary for any explanation that really explains. In other words, physical science has to take account both of the 'elements' and of their relationship or 'form.' And psychologists must do the same, noting not only such relations as are common to psychology and the physical sciences (time, for instance), but searching diligently whether there may not be some that are peculiar to our private mental life.

The general trend of the book, as can be readily seen, is to propose a more moderate estimate of psychology in general and of the laboratory work particularly. The later methods all come in for a drubbing: there is no quantitative work possible by psychological experiments; the brain physiologists can only borrow from psychology but give nothing in return; and child-study, with honorable exceptions, is something of a humbug. So that the general tone is a trifle disheartening to any of us who have faith in psychology and wish it well. As a counter-blast to those writings that magnify the office of psychology it may serve a good purpose. And since it is largely addressed to teachers, its chief benefit will undoubtedly be to remind them that a correct appreciation of the child and of the aims and ideals which are to be aroused in him is quite as important as a knowledge of the mechanism of the child's mind.

George M. Stratton.
University of California.

*The Races of Man.* An Outline of Anthropology and Ethnography. By J. Deniker, Sc.D. (Paris)–London. 1900. Walter Scott (American publishers, Charles Scribner's Sons). 611 pp., 176 illus., 2 maps.

The author of this handy text-book, forming Volume 37 in the Contemporary Science Series, is librarian of the Musée d'Histoire Naturelle in Paris. Moreover, he is a ripe specialist in human biology. Having, then, his own past experience as a guide, and being in touch with all the literature upon his theme, one is not surprised to find him interesting and instructive

at every point. We may divide the volume into three parts:

Part I. Somatic characters, morphological and physiological, Chapters I.–III.

Part II. Ethnic characters, linguistic, industrial, sociological, Chapters IV.–VIII.

Part III. Classification of races and peoples, general and ethnic, IX. to close.

The first and the third parts are the best written, being in the author's special line. One is always eager to find out the point of view of a work like this, and we are not kept in suspense. 'Ethnic groups' are at once separated from 'somatological units' or 'races.' The latter are "theoretic types formed of an aggregation of physical characters combined in a certain way." These entities, theoretic conceptions, are exactly like species in zoology. Here is Deniker's list:

| | | Races and Sub-races. |
|---|---|---|
| A. Woolly Hair, Broad Nose. | | |
| Yellow, short, dolicho. | | 1. *Bushmen* (s. r. Hottentots and Bushmen). |
| Dark skin. | Reddish-brown, short, sub-brachy, sub-dolicho. | 2. *Negrito* (s. r. Negrillo and Negrito). |
| | Black, tall, dolicho. | 3. *Negro* (s. r. Nigritian and Bantu). |
| | Brown, black, medium height, dolicho. | 4. *Melanesian* (s. r. Papuan and Melanesian). |
| B. Curly or Wavy Hair. | | |
| Dark skin. | Reddish-brown, leptorhine, tall, dolicho. | 5. *Ethiopian.* |
| | Chocolate, brown, platyrhine, medium dolicho. | 6. *Australian.* |
| | Brownish-black, short, dolicho. | 7. *Dravidian* (s. r. Platyrhine, leptorhine). |
| Tawny white, leptorhine, brachy., nose hooked, etc. | | 8. *Assyrioid.* |
| C. Wavy, Dark Hair, Dark Eyes. | | |
| Brown skin, black hair, nose narrow, tall, dolicho., ellipitical face. | | 9. *Indo-Afghan.* |
| Tawny skin, black hair. Tall. | Aquiline nose, dolicho. | 10. *Arab or Semite.* |
| | Straight nose, dolicho., square face. | 11. *Berber* (4 subraces). |
| | Straight nose, meso-, oval face. | 12. *Littoral European.* |
| | Short, dolicho. | 13. *Ibero-Insular.* |
| Dull white skin, brown hair. | Short, brachy, round face. | 14. *Western European.* |
| D. Fair, Wavy or Straight Hair, Light Eyes. | | |
| Reddish white | Wavy, reddish, hair, tall, dolicho. | 16. *Northern European.* |
| | Flaxen hair, straightish; short, sub-brachy. | 17. *Eastern European.* |
| E. Straight or Wavy Hair, Dark Eyes. | | |
| Brown, hairy; broad concave nose, dolicho. | | 18. *Ainu.* |
| Yellow skin, smooth body. | Prominent nose, tall; elliptical face, brachy or meso. | 19. *Polynesian.* |
| | Short, flat nose, high cheek bone, angular form, dolicho. | 20. *Indonesian.* |
| | Short, prominent straight or concave nose; meso- or dolicho. | 21. *South American* (s. r. Palaio-American, S. American). |
| F. Straight Hair. | | |
| Warm, yellow skin. Straight or aquiline nose | Tall, Meso. | 22. *North American* (s. r. Atlantic, Pacific). |
| | Short, brachy. | 23. *Central American.* |
| | Straight nose, tall, brachy, square face. | 24. *Patagonian.* |
| Brown-yellow, short, dolicho., round, flat face. | | 25. *Eskimo.* |
| Yellow-white skin. | Turned up nose, short, brachy. | 26. *Lapp.* |
| | Straight or concave, nose, short, meso- or dolicho., high cheek bone. | 27. *Ugrian* (s. r. Ugrian and Yeniseian). |
| | Straight nose, medium height, hyperbrachy. | 28. *Turkish or Turko-Tartar.* |
| Pale yellow, high-cheek bone, Mongol eye, slightly brachy. | | 29. *Mongol* (s. r. Northern and Southern). |

The succeeding table shows these races in their geographic contiguities.

The last chapters deal with the races by continents. Here the reader will find always references to the best special authorities where the author's statements are meagre. It is a pity that the Bureau of American Ethnology could

not have read the proof of names for this continent. It is a little difficult for the English reader to detect 'Shahaptian' in 'Chahaptes.' The Trenton gravel controversy is an open question, and Dr. Deniker should have left it so on page 511. He does the cause no good, and his friends, Wilson and Boule, harm in setting them up as a court of last appeal.

O. T. Mason.

*Malay Magic:* Being an Introduction to the Folk and Popular Religion of the Malay Peninsula. By Walter William Skeat, with preface by Charles Otto Blagdon. London, Macmillan & Co. 1900. Pp. xiv + 686, 7 figs., 28 plates. Price, $6.50.

The folk mind, everywhere, stands in the same relation to truth that a celestial globe occupies with respect to the heavens. Here and there a star is in the right place, but all the rest is fanciful. But truth is exact agreement between what is and what is said, so, notwithstanding folk-lore is fancy, the beliefs are actually held, and we may have the truth about them. No other student within our acquaintance is better equipped for a work of this kind than Mr. Skeat.

Folk-lore, in this volume, is taken to mean the lore of the uncivilized races, containing in the germ, as yet undeveloped, the notions from which religion, law, medicine, philosophy, natural science and social customs are evolved. The operative side of living is excluded, but the regulative thoughts are folk-lore.

The word Malay incidentally includes with the people of that race in the peninsula others of the same blood near by, but the lore of the Chinese and other non-Malayan folk is excluded. The magician is the middle man between Malays and the spirit world. If he knows and reveals, he is *Pawang;* if he heals, he is *Bomor.* All that either does or says is classed by Mr. Skeats under magic. The Malays have had a series of religions, to wit, the aboriginal cult, which is a primitive sort of Brahmanism, with extensive pantheon, Buddhism and Mohammedanism. Now, it is easily comprehended, as Mr. Skeat shows, that these *Pawangs* and *Bomors* have nothing to do with *Imams, Khatibs* and *Bilals* of the mosques. Also, if the reader is familiar with the present cult of the Latin American tribes, or of the Filippinos, he would not be shocked to see a long string of Malay invocations and magical rites performed before Hindu divinities, demons, ghosts and nature spirits, beginning with: "*In the name of God, the Merciful, the Compassionate,*" and ending with: "*There is no god but God, and Mohammed is His prophet.*"

In order to prepare the way for a better comprehension of Malay magic the author devotes the first fifty pages to native cosmogony, anthropogony, animism and notions about souls. Nearly as many pages discuss the world of spirits, the Malay pantheon and its relation to our world, as well as the class of men who act as go between from world to world.

The remainder of the work gives us the story of Malay beliefs and practices concerning fire, air, earth, water, and the life of man, in which the spirit world is involved, together with the description of paraphernalia the recital of formulæ, prayers, sacrifices, lustrations, fastings, divinations and witchcraft involved. Wisely, in the midst of so much jumbling of ethnic creeds and cults, the author abstains from attempts to analyze, and contents himself with recording in the most scrupulous manner the data on which philosophic discussion must be based. Pages 581–672 are devoted to Malay texts.

It would be unkind to point out little errors and omissions, since an enforced absence from England prevented the author from revising the proofs. The illustrations are not so good as those of Dr. Fewkes along the same line published by the Smithsonian Institution.

O. T. Mason.

*Plant Structures.* A second book of Botany. By John M. Coulter, A.M., Ph.D., Head of Department of Botany, University of Chicago. Twentieth Century Text-Books. D. Appleton & Company. 1900. Pp. x + 348. 12mo, with 289 illustrations.

Several months ago the companion volume to the work now under review appeared, and was noticed in Science (December 8, 1899). That volume was designated as 'a first book of

botany,' while this is said to be 'a second book.' The former ('Plant Relations') attempted to treat the subject from an ecological standpoint, and in our opinion the author failed to make it 'a first book'; in the present volume morphology is the dominant subject, and, as if in some doubt himself, the author says in the preface: "It may be, however, that many teachers will prefer to begin with the morphological standpoint as given in this book. Recognizing this fact 'Plant Structures' has been made an independent volume that may precede or follow the other, or may provide a brief course of botanical study in itself." This remarkably flexible purpose has been well carried out by the author. He has made an excellent *first* book of botany, in spite of its title.

The book follows the approved sequence from the simpler to the more complex plants, and the treatment is that which has been developed in the best botanical laboratories. The very helpful 'Suggestions to Teachers,' prepared by Dr. Caldwell to accompany the book, emphasize the practicability of the course here outlined. One feels as he runs over the pages that he is on ground which has been traversed again and again by teachers and pupils, and that all the work outlined *can* be done, because it *has been* done again and again.

We should like to take up the chapters in detail, but that cannot be done in a brief notice. We could ask here and there for a less confusing sequence (*e. g.*, where Slime Moulds and Bacteria are taken up after Toadstools and Puffballs, and Coleochæte in the midst of the Bryophytes), and far less of generalization before the pupil has some facts in hand (*e. g.*, in Chapter III., where the evolution of sex is discussed when he is as yet in total ignorance of the structural facts on which the theory is hung). On the other hand, the author's generalizations in the form of summaries from preceding groups (*e. g.*, Thallophytes, Bryophytes and Pteridophytes), are admirable.

The illustrations are good, and well chosen. Many have a delightful freshness, in sharp contrast to the well-worn cuts so long familiar in similar text-books.

CHARLES E. BESSEY.

THE UNIVERSITY OF NEBRASKA.

*Observations made at the Blue Hill Meteorological Observatory, Massachusetts, U. S. A., in the Years 1897 and 1898.* Under the direction of A. LAWRENCE ROTCH, A.M. With an Appendix containing the *International Cloud Measurements during 1896–97.* Annals of the Astronomical Observatory of Harvard College. Vol. XLII. Part II. 4to. Cambridge, 1900. Pp. 131–280.

The cloud work done at Blue Hill Observatory is known to meteorologists the world over, the publications on clouds already issued by this Observatory having been among the most important contributions to meteorology in recent years. This satisfactory result has been made possible through the liberality of Mr. A. Lawrence Rotch, the founder and director of the Observatory, and through the admirable work done at the Observatory by Mr. H. Helm Clayton and his associates, Messrs. S. P. Fergusson and A. E. Sweetland. Mr. Clayton's *Discussion of the Cloud Observations* made at Blue Hill (Annals Harv. Coll. Obs'y, Vol. XXX., Part IV.), is the most complete publication on clouds ever issued (see SCIENCE, N. S., Vol. V., 1897, pp. 468–469). When the 'International Cloud Year' was begun on May 1, 1896, in accordance with the recommendation of the International Meteorological Committee in 1894, the Blue Hill Observatory was one of the stations in the United States which co-operated in this special work, the other stations being those under the jurisdiction of the Weather Bureau. The present volume includes the usual meteorological observations made during 1897 and 1898, publication of which was delayed in order that an appendix containing a discussion, by Mr. H. H. Clayton, of the *Measurements of Cloud Heights, Velocities and Directions*, carried out during the 'Cloud Year,' might be included. In this Appendix are printed the tables containing details of all the cloud observations made throughout the 'Cloud Year,' together with tables showing the mean heights and mean velocities of the clouds at different hours and seasons; the number of clouds and measurements; the mean, maximum and minimum heights and velocities by months; the mean heights with different temperatures and pressures; the mean heights with different gradi-

ents; the mean heights of clouds from different directions; the mean velocities and frequencies of the clouds at different heights; the frequencies of the different currents at different heights, etc. The mere enumeration of the headings of these tables will suffice to show the thoroughness of the work discussed in this volume—a thoroughness which is characteristic of all of Mr. Clayton's cloud studies. The text accompanying the tables discusses the methods of measurement and of computation employed, and the meteorological results of the investigation. It is impossible to present any adequate summary of the important results reached by Mr. Clayton. Those who seek further information should turn to the volume itself, which is worthy of careful study. There is, however, one point which we would notice here. From a series of special measurements of cumulus and fracto-cumulus clouds, made with a view to determining the relation between the heights of these clouds as obtained by theodolites and from the dew-point, it appears that turreted cumulus clouds are most frequent at the coldest time of day, and not at the warmest, as is the case with ordinary cumulus. Thus, as Mr. Clayton points out, it seems that the diurnal period of the turreted cumulus is not determined by heating at the ground but by cooling at the surface of the cloud. The turreted cumulus probably forms only when the decrease of temperature from other causes approaches the adiabatic rate. It is thus an indication of thunderstorms, for a rapid vertical decrease of temperature in the upper air, when combined with a rapid decrease in the lower air caused by heating at the ground, favors the ascent of columns of air from the ground, to great heights and this is a condition favorable to thunderstorms.

The present volume is fully worthy to take its place in the line of Blue Hill Observatory publications as another important American contribution to meteorology.

R. DeC. Ward.

BOOKS RECEIVED.

*Text-Book of Paleontology.* Karl A. von Zittel. Translated and edited by Charles R. Eastman. London and New York, The Macmillan Company, 1900. Pp. ix + 706.

*Volumetric Analysis.* John B. Coppock. London, Whittaker & Co.; New York, The Macmillan Company. 1900. Pp. 92.

*The Soul of Man.* Paul Carus. Chicago, The Open Court Publishing Company. 1900. Pp. xviii+482.

*The Teaching of Elementary Mathematics.* David Eugene Smith. New York and London, The Macmillan Company. 1900. Pp. xv + 312.

*The Criminal, his Personnel and Environment,* a scientific study. August Drähms, with an Introduction by Cesare Lombroso. New York and London, The Macmillan Company. 1900. Pp. xiv+40.

## SOCIETIES AND ACADEMIES.

### THE PHILOSOPHICAL SOCIETY OF WASHINGTON.

At the 514th meeting of the Society, held at the Cosmos Club on March 3d, Professor C. Abbe read an obituary notice of Professor H. A. Hazen. Dr. L. A. Bauer, then gave a detailed statement of the methods to be pursued in carrying out the magnetic survey of the United States by the Division of Terrestial Magnetism of the U. S. Coast and Geodetic Survey.

As an indication of the scope and character of the data to be derived from the detailed magnetic survey of the United States, a brief statement was given regarding the results obtained from the detailed magnetic surveys of Maryland and of North Carolina. Furthermore there were exhibited various charts giving a graphical analysis of the earth's magnetic field for various portions of the United States.

With the aid of these charts, it was shown very clearly how inadequate it is for the formation of theories of the earth's magnetism to have simply declination data alone.

Following Dr. Bauer's paper, Dr. Alexander Macfarlane of Lehigh University, discussed the 'Square Root of minus one.' He reviewed the explanations published by Payfair, Buée, Argaud, Français, Gauss, Cauchy, Boole, Hamilton, Cayley and other mathematicians and concluded that $\sqrt{-1}$ does not indicate direction nor rotation of the quantity to which it is attached, nor a turning of the plane of representation, nor a special unit; that + and − are not signs of addition and subtraction but are signs of affection, and so is $\sqrt{-1}$. He gave analytical expressions for these signs, which

show their connection with $\pi$ and applied them to explain the rule of signs, the roots of + and —, the logarithm of quantities, the fundamental rules of quaternions and vector-analysis, the analogy of the circle to the hyperbola, and imaginary intersections.

E. D. PRESTON,
*Secretary.*

### THE TEXAS ACADEMY OF SCIENCE.

THE regular monthly meeting of the Texas Academy of Science was held in the Chemical lecture room of the University of Texas on Friday evening, February 16th, President Simonds in the chair.

Dr. H. Y. Benedict, Instructor in Mathematics and Astronomy in the University, spoke on 'Astronomy in the XIX. Century' which took the form of a summary of achievements in that branch of science during the past hundred years. First he considered the additions to instruments, the invention of which had materially assisted in the refinement and increase of our knowledge, special mention being made of the spectroscope, camera, photometer, etc.

Additions to the solar system constituted the next topic. These were both numerous and important, including one planet—Neptune—its satellite, the two satellites of Mars, the fifth of Jupiter, Hyperion and the ninth of Saturn, and the two of Uranus.

The cometary and periodic movements of meteorites were mentioned as were also the measurements of the parallaxes of the fixed stars.

The last topic, the 'Nebular Hypothesis and the Theory of Tidal Evolution,' aroused considerable enthusiasm. Among those who took part in the discussion were Professors Halsted, Harper, Ellis and Mezes. Throughout the paper it was made plain that in the astronomical work of the century Americans had played a leading part.

Dr. L. E. Dickson, Associate Professor of Mathematics, presented a paper entitled 'An Elementary Account of the Greater Problems solved by the Modern Group Theory.' Among the examples chosen to illustrate the definition of a group, the most elementary was that of the three distinct rotations of a plane triangle into itself, viz, the right-hand and the left-hand rotations through 120° and the zero-rotation called the identity. Denoting them by $R$, $L$, $I$, respectively, it is seen by inspection that

$$R^2 = L, \quad L^2 = R, \quad RL = LR = R^3 = L^3 = I,$$

so that the result of applying any one of the three and afterwards any one of the three is equivalent to applying some single one of the three. The corresponding permutations of the three vertices give rise to a 'group of substitutions.'

The connection between rational, integral functions and groups of substitutions was illustrated by several examples. The solution of the quadratic and cubic equations was made to depend upon the determination of very simple non-symmetric functions of their roots. After indicating the impossibility of solving by radicals the general equation of degree $n > 4$, the question of the solution of special equations was declared to be a problem capable of most direct answer by employing the group of the equation, as developed by Galois. A problem in mathematics usually depends upon the solution of an algebraic equation or upon the integration of a differential equation. By considering the group of the equation, finite in the former case and continuous in the latter, we are able to decide whether or not the equation can be solved by radicals or integrated by quadratures. More generally it tells what series of simple problems may be taken in place of the original problem. The group of a problem not capable of such a reduction to a chain of simpler problems is called simple. To borrow a chemical term, these simple groups are the 'elements,' to which any problem in its final analysis is to be reduced. The present state of our knowledge of these elements was discussed both for finite groups and for continuous groups.

Professor Thos. U. Taylor, M.C.E., read an abstract of his report to the U. S. Geological Survey on 'The Silting up of Lake McDonald, Austin, Texas.' This is the body of water retarded by the erection of the great dam across the Colorado River. A comparison of the cross-sections of the lake at sixteen different stations, averaging 1¼ miles apart, for 1893

and 1900, shows that the lake had silted up 48 per cent. of its original storage capacity; that when reduced to a square mile base there was in 1893 a storage capacity of 81 feet in depth, but in 1900 only 42 feet. This result, reached in the space of $6\frac{2}{3}$ years, gives an average of 5.8 feet of silt per year on the mile base. According to the laws of silting the deposit was for the first year 7.5 feet, for the second year 6.9 feet, for the third year 6.2 feet, etc. The silt in the upper two miles of the lake is mostly sand, while that of the lower two-thirds is composed of a fine, impalpable, absolutely gritless deposit. The Colorado River flows through a hilly country for hundreds of miles, and is not a heavy silt-bearing stream except on the Red Fork.

F. W. S.

University of Texas.

## THE ACADEMY OF SCIENCE OF ST. LOUIS.

At the meeting of the Academy of Science of St. Louis of March 5, 1900, forty-two persons present, the following subjects were presented:

'An Annotated Catalogue of the Muricidae,' by Mr. F. C. Baker, was presented by title.

A paper by Professor A. S. Hitchcock, entitled 'Studies on Subterranean Organs.' II. 'Some Dicotyledonous Herbaceous Plants of Manhattan, Kansas,' was presented in abstract and illustrated by specimens.

Mr. J. S. Thurman addressed the Academy on 'Liquid Air,' tracing the history of the liquefaction of gases and in particular the success reached in liquefying air since this result was first achieved in 1877 by Pictet and Cailletet. The possibilities of the utilization of liquid air as a motive power and an explosive, and its employment in medicine and as a disinfectant, were passed in analytic review by the speaker, whose conclusions were that there seemed no present probability of its useful application either as a disinfectant or a motive power. In medicine and for certain purposes requiring the use of explosives it was stated to be not impossible that it would ultimately find useful application, although its prospects as an explosive did not seem very promising.

Four persons were elected active members of the Academy.

William Trelease,
*Recording Secretary.*

## *ANTI-PLAGUE INOCULATION.*

The Indian Plague Commission have made public through the India office part of their report, including the following paragraphs in regard to anti-plague inoculation:

With regard to the feasibility of adopting a general policy of inoculation, our conclusion may be set forth as follows:

(1) Experience gained hitherto has shown that it is very seldom possible to get a large proportion of the inhabitants of an uninfected place inoculated.

(2) It has been possible, where the inducement of exemption from segregation and eviction has been offered, to get a large proportion of the inhabitants of an infected place inoculated quickly.

(3) It has been possible in one place—Mysore City—even where no inducement that touched the great mass of the people could be offered, to get a considerable proportion of the inhabitants of an infected place inoculated quickly.

(4) It has been possible also to induce a large proportion of particular communities, such as the Khojas of Bombay and Karachi, to be inoculated under the influence of their leaders.

Our recommendations are governed by those conclusions, as well as by the conclusions we have already drawn with regard to the protection conferred by inoculation. They are further governed by the consideration that it is necessary, as far as may be possible, to dispel the particular objections on account of which the people have hitherto refrained from inoculation. Moreover, our recommendations are based on the consideration that it is advisable to make the operation as effective as possible, as little inconvenient as possible to the person inoculated, and as easily carried out as possible by the inoculator.

I. We have already insisted on the necessity for the accurate standardization of the vaccine, as being essential to the attainment of the best results, both as to the protection conferred and as to the duration of that protection. We have pointed out, also, that the introduction of an accurate system of standardization may possibly obviate the necessity of employing two successive inoculations.

II. With a view to dispelling the natural

fears of the people and avoiding all unnecessary risk to the inoculated, and, further, with a view to enabling the inoculations to be carried on with the least possible amount of attendant inconvenience, we would insist upon the necessity that stringent precautions should be taken to insure that all the vaccine used is quite free from contamination, and we would recommend that the volume of the necessary dose should be made as small as possible.

III. With a view to removing any possible ground for distrust as to the conveyance of disease by inoculation from one person to another we would recommend that the syringe should be sterilized in the presence of the person about to be inoculated.

IV. We are of the opinion that inoculations, under the safeguards and conditions stated above, should be encouraged wherever possible, and, in particular, it seems to us desirable to encourage inoculation among disinfecting staffs and the attendants of plague hospitals.

We cannot bring to a conclusion this consideration of anti-plague inoculation by Mr. Haffkine's prophylactic fluid without expressing our sense of the importance of the method which Mr. Haffkine has devised and of the results which have been achieved by it. The credit due to Mr. Haffkine is the greater because the difficulties with which he had to contend in this matter could only have been overcome by great zeal and endurance. Mr. Haffkine's work on anti-plague inoculation, while not based on any new scientific principle, constitutes, it seems to us, a great practical achievement in the region of preventive medicine.

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### *SPIRIT-LORE OF THE MICRONESIANS.*

RECENTLY the director of the ethnographic division of the royal museums at Berlin has returned from a prolonged visit to the Sunda islands, Micronesia and Melanesia, and is now able to give to the world the multifarious results of his observations and researches. Micronesia had heretofore been studied in part only, as far as its ethnography is concerned, and it was chiefly the Pelew islands that had attracted a share of attention from German scientists; although the Mariana islands had been considered also. Research has now been made much easier by the number of colonies which Germany has established in this insular domain.

The entire group of the Carolinian islands, with a native population of about 30,000, is what Director Adolph Bastian chiefly describes in his recent publication, 'Die mikronesischen Colonien aus ethnologischen Gesichtspuncten,' Berlin, 1899. Octavo, pp. 7 and 370. To begin with, Dr. Bastian gives a sketch of the social life of the Pelew nation, of their chiefs, notables and government. Then follow his observations on mortuary rites, their theories about death, the soul after death and the mutual intercourse of souls. Then are discussed Malay theories of black and white magic (whatsoever this may be), of demonology, the tutelary genii, the creation of the world, evolution and what we call the infinite. The demonology is among the Malays weird and fantastic, as might be expected, but also highly poetical and full of originality. For many years back the white race has been informed of the religious views and mythology of the Maori, the Samoa, Tonga and Mangaia islanders, and there is no denial of the fact that the cosmogony and spirit-worlds of these natives are as grand in their conception as those of many peoples of European antiquity. Their systems of the world and of after-life come very near the metaphysical, and when the European who transmits these views to us is himself a philosopher, or at least a thinker, he will make the Malay systems appear to us so much the more philosophical. Dr. Bastian, being a votary of the comparative method in ethnology, has for every myth, custom or belief a score of parallels ready, which he takes from Mediterranean, African, American or any other tribes or nations of the globe, or historic comparisons of beliefs from Greece, Rome, Mesopotamia, China, or Mexico. Anyone able to follow Bastian in his vast amount of reading (his quotations of sources are *summary* and therefore of little use), will undoubtedly derive benefit from what he states. But these statements are given in a manner that is too chaotic and profuse and most readers find it too difficult to follow the thread of his argumentation.

Oracles through whistling are found throughout these islands. Their main gods transmit

their behests to men through ghosts or dead children by whistling sounds or whispered words. Tattooing is permitted only when a deity has given his assent by whistling; house spirits and the genii of trees give their revelations by whispers only. A. S. G.

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*APPLIED THERMODYNAMICS.*

In a recent publication of '*Documents sur la Laboratoire de Mécanique de l' Université de Liége*,' describing its methods of instruction, by the Professor of Applied Mechanics and of Industrial Physics, M. Dwelshauvers-Dery, we find a *resumé* of researches in applied thermodynamics, mainly in the experimental study of the steam-engine, which is interesting as exhibiting the character and extent of the work recently performed, and valuable as supplying important data previously unknown.

This laboratory of applied mechanics was completed in 1893, after, as the author of these documents says, five years of constant solicitation of the government to supply this '*auxiliaire précieux*,' of which M. Dwelshauvers-Dery was the first to conceive the idea, a generation ago, though so late in its realization. His idea was that of a laboratory of research and instruction in engineering, to be employed in the work of the regular courses leading to technical degrees and devoted to the purposes of the student, rather than, as previously usual in nearly all departments of applied science, primarily for those of the distinguished professor in charge and only secondarily and incidentally for the student.

The researches which have been conducted since the date of completion of this laboratory by the Director, assisted by his staff and by advanced and able students, have been mainly in applied thermodynamics. M. Dwelshauvers-Dery is a disciple of Hirn and aided in the investigations made in Alsace at the beginning of the work of his eminent leader. Since that time, the famous discussion between Zeuner and Hirn and their followers has made this work and these workers familiar to all investigators and students in that field. It has been in the supplementing of Hirn's earlier work that the experimental steam-'plant' at Liége has been mainly occupied recently.

Among other investigations, those relating to the influence of the water collecting in the steam-chest of the engine upon its efficiency, on the effect of superheating, on the use of the steam-jacket, on the effect in the real engine of compression, and those on the condition of the vapor, as to 'quality,' in the clearance spaces, have been the most extensive and important.

It was found to be the unquestionable fact that, with the engine employed, it was advantageous to continually drain the water of condensation from the valve-chest of the engine when using moist steam and whether the jacket is in use or not. With superheated steam, naturally, no effect was observed.

The steam-jacket was found to give an economy of from 24 to 28 per cent., either with or without superheating; the latter being a disputed question until thus, for this case, at least, settled. Superheating produced an economy of about 20 per cent., as a maximum.

The investigations of the quality of the vapor in the compression period occupied several years and attracted much attention and some opposition to the conclusions reached was manifested by a number of distinguished experts in that department. Those experiments which were made with 'constant absolute work' showed a decided loss by compression and a loss proportional to the amount of the compression; which fact was attributed to the heat-exchanges between vapor and cylinder-wall. This conclusion was challenged and it was denied that the fundamental assumption that, as asserted by Hirn, the steam at the end of emission is dry, could be accepted as true. Dwelshauvers-Dery and his former assistant and pupil, Duchesne, furnished proof of the correctness of his proposition. (Revue de Mécanique, Jan., 1899; July, 1899.)

Mr. Isherwood, the famous pioneer in this class of work and the Engineer-in-chief of the navy during our civil war, suggested that the experiments be repeated, making the 'indicated work' a constant quantity. He thought it possible that it might be found that the use of compression was neither economical nor wasteful in the actual case and, therefore, its use simply a question of smoothness of operation of the machine and entirely outside

the realm of applied thermodynamics. The work of the past year has been in this line of investigation and the results have sustained the view of Commodore Isherwood.

The schedule of proposed work for the year 1900 includes the study of the effect of 'throttling' steam, as proposed by Isherwood.

The publication of these documents for the use of the Congress of Applied Mechanics at the coming International Exposition at Paris gives all interested in this department of research and in this kind of instruction an opportunity to learn just what are the methods employed, the apparatus used and the character of the researches best adapted for laboratory work of this sort in the instruction of the young engineer and physicist, as arranged by a pioneer in this field.* The work reported has been extensive, important and admirable in method and in its execution. It has been conducted under circumstances of very great difficulty, patiently, carefully, persistently, and while few who have not kept in touch with it while in progress can realize what labor and sacrifice have been involved, every specialist in this department will recognize its value and elegance.

R. H. THURSTON.

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*A NEGLECTED DEPARTMENT.*

THE American Society of Mechanical Engineers is issuing to its members a circular, prepared by its Council, calling attention to the neglect of the Patent Office of the United States by Congress, to its importance to the country and to its hoppled condition as produced by the refusal of Congress to provide for either suitable accommodations or a sufficient clerical force and staff of examiners. Members of the Society are urged to force upon the attention of their members of Congress the necessity of "providing sufficient room, force and facilities for the prompt and proper execution of its work," that arrangements be made at once for "providing incombustible receptacles for the records," which records "largely constitute the legal evidence of title of so many of the larger industries of the country," that the library be kept up and properly cared for, that the Patent Office be given the entire control and use of its own building—now occupied largely by 'squatters' from other bureaux—and that its earnings be dedicated to its own purposes and improvement. The Patent Office is 'out of practical politics,' and is only prevented from doing its full duty to the country by its lack of space and of force. Yet, up to January 1, 1899, 693,979 patents had been granted, and 41,422 trade-marks registered. Last year alone 25,527 patents and 2260 trade-marks were added to the record. The accumulations of records and of exhibits has come to be so great as to put it quite beyond the power of the restricted force in its restricted space to properly store, arrange, classify and care for them. The library, which it is imperatively necessary to keep up to the highest state of efficiency, and which should be a complete collection of the technical publications of the world, and of all time, was last year only allowed $1500 for purchases of books. No funds at all were obtainable for the law library. The whole business of this department of government, upon which the success of our great industries is so absolutely dependent is trammelled, and every industry of the country is embarrassed, by its forced inefficiency. This inefficiency is entirely due to the indifference of Congress. The Patent Office has accumulated out of its own earnings a large amount of available capital—several millions of dollars—and it has not been even allowed to draw upon its own funds to meet imperative needs.

So indifferent, in fact, have been some Congresses that it is within the experience of the writer that important matters of business, involving large interests, have been delayed for weeks through the impracticability of securing a full meeting of a committee, repeatedly called.

R. H. THURSTON.

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*MUSEUM OF THE STATE OF NEW YORK.*

DURING the winter season, the energy of the museum staff has been concentrated on an im-

* Documents sur le Laboratoire de Mécanique de l'Université de Liége, et sur l'Enseignement qui y est donné par V. Dwelshauvers-Dery, Professeur de mécanique appliquée et de physique industrielle. Liége, Charles Desoer, Editeur, 1900.

portant series of publications. A bulletin on the clay industries of the State will soon be issued, being a second edition of one prepared in 1893. A report on the lime and cement of the State is nearly ready for the printer. Work is also rapidly progressing on the new edition of the geologic map of the State on the scale of five miles to the inch.

A NEW edition of the Economic and Geologic map published in 1894 is almost ready for the engraver. It is on a slightly enlarged scale and will contain a large amount of additional information. A relief model of Niagara River and the vicinity of the Falls on the scale of 1000 feet to the inch is being prepared by Mr. Edwin E. Howell, of Washington, D. C., for exhibition at the Pan-American exposition in Buffalo.

THE sixteenth annual report of the State geologist being the report of work done during the incumbency of the late Professor James Hall, has been issued. It contains a number of papers of importance, among them,

'Report on the boundary between the Potsdam and Pre-Cambrian rocks north of the Adirondacks,' by H. P. Cushing.

'The Naples fauna in western New York,' by John M. Clarke.

'The brine springs and salt wells in the State of New York and the geology of the salt district,' by D. D. Luther.

'The faunas of the Hamilton group of Eighteen-mile creek and vicinity,' by A. W. Grabau.

THE department has received from Professor C. E. Beecher, of Yale University, a natural size restoration of the immense crablike crustacean *Stylonurus excelsior*, the largest invertebrate animal that has been found in the rocks of New York. It attained a length of about five feet, and its remains were found in the Catskill rocks of Delaware county.

Dr. J. M. CLARKE lectured on the 24th ult. in the Columbia University series on the 'Geological History of Parasitism' and will repeat the lecture before the Rochester Academy of Science.

A BULLETIN on early and recent sites of the Indian tribes of the State, illustrated by two maps, will soon be received from the printer.

IN zoology, the biological survey has been continued and volunteers have been organized to observe and report on the birds of New York. This is in continuance of the biological work originally begun under the natural history survey which led to the publication of the reports on zoology and botany in 1824, and which, though for some time suspended for lack of funds, was revived two years ago in the study and collection of fishes of Long Island by Dr. Tarleton H. Bean, and the preparation of a bulletin on the Mammals of New York, together with a key to their identification, now in press.

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## *CURRENT NOTES ON METEOROLOGY.*

### THE RELATIVE HUMIDITY OF OUR HOUSES IN WINTER.

'The Relative Humidity of our Houses in Winter' is the subject of a paper by R. De C. Ward in the *Boston Medical and Surgical Journal* for March 1st. Observations were made by means of an ordinary sling psychrometer in a furnace-heated room during three weeks of last November. The mean relative humidity in the room for the whole period was 30%, while the mean relative humidity outdoors during the same period was 71%. The minimum relative humidity observed for any whole day was 24% and the maximum for a whole day was 40%. For purposes of comparison, the relative humidities of several stations in arid regions are given in the paper. For instance, the lowest mean annual relative humidity in the United States is that for Yuma, Ariz., which has 42.9%, and a mean monthly minimum of 34.7% in June. Sante Fé, N. Mex., has a mean annual of 44.8%, with a mean monthly minimum of 28.7% in June. Death Valley, Calif., was found to have a mean relative humidity of 23% during five months (May–September) of the year 1891, when a temporary meteorological station was maintained there by the Weather Bureau. Southwestern Siberia and Western Turkestan have a mean of 45–50% in July. Ghadames, in Tripoli, has 27% in July. In India, Lahore has 31% and Agra 36% in May. It thus appears that the air of the room in which the observations were made was drier than that of many desert regions.

### DRUNKENNESS AND THE WEATHER.

SCIENCE for August 11th last contained an

interesting paper by Dr. E. G. Dexter, entitled 'The Mental Effects of the Weather' in which the relations between certain weather elements and the occurrence of certain misdemeanors in New York City were discussed. In *Nature* for February 15th, Dr. Dexter returns to this subject in a communication which is supplementary to the article just referred to. In this note the writer refers to the results of a study made by him to determine the relation between temperature conditions and drunkenness in New York City. The number of arrests (males) for drunkenness for each day during the three years, 1893–1895, was taken from the records of the New York police force. The mean temperature, pressure, humidity and wind movement for each of these days were obtained from the records of the Weather Bureau in New York City. The curve showing the number of arrests for drunkenness plotted with reference to the twelve months of the year shows that the prevalence of intoxication during the cold months is much in excess of that for the warm ones. The curve of arrests for drunkenness plotted with reference to mean temperatures also shows, as a whole, a decrease in the number of cases of intoxication with increasing temperature.

INTERNATIONAL METEOROLOGICAL CONGRESS.

AN International Congress of Meteorology is to be held at Paris from September 10th to 16th of the present year. The President of the *Commission d'Organisation* of the Congress is M. Mascart, Director of the Central Meteorological Bureau of France. The Secretary is M. Angot. Membership in the Congress may be had on payment of 20 francs. The preliminary program includes a long list of subjects in meteorology proper, as well as in oceanography, and terrestrial magnetism and electricity.

RETIREMENT OF MR. R. H. SCOTT.

IT has already been announced in this JOURNAL that Mr. R. H. Scott, F.R.S., was to retire from the post of Secretary to the Meteorological Council of the Royal Society on February 28th. At the end of the year 1899, Mr. Scott had completed 33 years of service in the Meteorological Office, and for the last 25 years he has acted as Secretary of the International Meteorological Committee. Mr. Scott is to be succeeded by Mr. W. N. Shaw, P.R.S., Fellow of Emmanuel College, Cambridge, and up to this time Assistant Director of the Cavendish Laboratory, and Lecturer in Physics in the University of Cambridge.

R. DEC. WARD.

HARVARD UNIVERSITY.

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## *SCIENTIFIC NOTES AND NEWS.*

PROFESSOR P. TACCHINI has resigned the directorship of the Royal Italian Bureau of Meteorology and Geodesy after forty years of service. Professor Luigi Palazzo has been appointed temporary director.

THE Royal Academy of Turin has elected Dr. Charles S. Minot a corresponding member.

PROFESSOR MITAG-LEFFLER of Stockholm, has been elected a corresponding member of the Paris Academy of Sciences in the Section of geometry.

GLASGOW UNIVERSITY has offered the degree of LL.D., *honoris causa*, to Mr. A. Smith Woodward, the vertebrate paleontologist of the British Museum.

THE University of Aberdeen will confer the degree of LL.D. on Mr. W. R. Sorley, professor of moral philosophy in the University of Aberdeen.

MR. DEAN C. WORCESTER, whose appointment as a member of the new Philippine Commission we announced last week, has resigned the assistant professorship of zoology in the University of Michigan. It is reported that Mr. Worcester has been offered a salary of $15,000 a year as manager of certain mining interests in the Philippine Islands and that when his duties as commissioner are fulfilled he may accept the offer. His salary at the University of Michigan was $1600.

PROFESSOR PERRY G. HOLDEN has resigned the chair of agriculture in the University of Illinois to become manager of the agricultural department of the Illinois Sugar Refining Company.

Mr. W. A. Taylor, assistant chief of the division of pomology, department of agriculture, has sailed from New York to take charge of

the United States exhibit of fruits at the Paris Exposition.

THE Rumford medal, which, as we announced sometime since, was awarded by the American Academy of Arts and Sciences to Mr. Charles F. Brush, was presented to him at a meeting held last week in Boston. Professor Charles R. Cross, of the Massachusetts Institute of Technology, Chairman of the Rumford Committee, made a brief address, describing the grounds for the award and the arc lamp invented by Mr. Brush; Professor Trowbridge presented the medal and Mr. Brush made a reply. Professor Elihu Thomson read a paper describing a new method of producing an electric current of high voltage.

COLUMBIA UNIVERSITY has been given a statuette of Professor Charles Hackley, who held the chair of mathematics and astronomy in Columbia College from 1843–1861.

WE regret to record the death at her home in New York city, of Miss Catherine Wolfe Bruce, who made generous gifts for the advancement of astronomy to Harvard University, Columbia University and other institutions.

M. EMMANUEL LIAIS, Mayor of Cherbourg, has died at the age of seventy-four. For many years he held posts at the Paris Observatory, and he was sent in 1857 to South America to watch the solar eclipse. He organized telegraphic meteorology in France, and devised the use of chronographs in determining longitude by electricity. He bequeaths his property to the municipality of Cherbourg in trust for scientific purposes.

DR. WILLIAM MARCET, F.R.S., died at Luxor, Egypt, on March 4th, in his seventy-second year. He had been president of the Royal Meteorological Society, and was the author of books on health resorts and on the history of the respiration of man.

DR. F. JAGOR, known for his scientific expeditions, died at Berlin on February 11th, at the age of 83 years.

DR. CARL MARIA PAUL, geologist of the Austrian bureau, died at Vienna on February 10th.

MR. JAMES G. SMITH, one of the inventors of the duplex system of telegraphy, died in New York City, on March 13th.

THE Fish Commission steamer *Albatross* has arrived at Yokohama. After refitting, the vessel will proceed to Alaska for the purpose of continuing the investigations in the salmon streams begun some years ago.

AN expedition consisting of Professor E. B. Poulton and Mr. E. S. Goodrich, from Oxford University, and Messrs Oldfield Thomas and R. I. Pocock, from the British Museum, is just starting for the Balearic Isles to make zoological collections. Although within easy reach, these islands are still little known to naturalists, so that the collections, if containing no novelties, will be of much service in completing the faunal series of the London and Oxford Museums.

MRS. PHOEBE HEARST has undertaken to defray the expenses of explorations and excavations in various parts of the world, to secure collections for the archæological museum to be established at the University of California. Dr. George A. Resinel is expected to have charge of the work in Egypt; Dr. Alfred Emerson in Greece and in Etruria; Dr. Euler in South America and Yucatan, and Dr. P. M. Jones in California and Mexico.

DR. J. W. GREGORY, the new professor of geology at Melbourne, has been appointed director of the scientific staff on the British Antarctic Expedition, which, as at present arranged, is to start in August, 1901. It is to be hoped that Dr. Gregory's recent severance from the British Museum will not prevent the natural history collections coming to that establishment as was originally intended. Another scientific man who thinks of taking a trip to the Antarctic is Dr. Otto Nordenskiöld.

THERE will be a Civil Service Examination, on April 17th, to fill the position of Field Assistant in the Division of Forestry, Department of Agriculture, at a salary of $1000 per annum.

BELGIUM has established a botanical garden and experiment station at Coquilhatville in the Congo Free State.

A BRANCH of the American Chemical Society has been established for the State of Michigan, with its headquarters at the University of Michigan. The first officers are: *Presiding Officer*,

Professor A. B. Prescott; *Secretary*, Alfred H. White; *Councillor*, Professor Paul C. Freer—all of the University of Michigan. The members of the executive committee are: A. F. Shattuck, chemist to the Solvay Process Company, Detroit; Professor F. S. Kedzie of the Agricultural College, and J. V. Wolfe, Jr., chemist to the Detroit Sugar Company at Rochester.

THE New York *Evening Post* reports that a contract to slaughter 20,000 birds of all sorts near Milford, Delaware, for the benefit of a millinery firm in New York, has aroused a storm of indignation. Fully a dozen societies, headed by the Academy of Natural Science have taken action to prevent the killing of the birds. A notice denouncing the proposed slaughter has been sent out by Mr. Witmer Stone, Chairman of the American Ornithologists' Commmittee on Bird Protection. The committee will prosecute wherever the law is violated.

THE *Scientific American* states that the Geographical Society of Philadelphia is to continue its work of setting wooden casks adrift on the ice north of this continent, to demonstrate the currents of Arctic waters north of Behring Strait. Each cask will contain a blank to be filled in by the finder.

READERS of this JOURNAL have doubtless noticed in the daily papers the announcement of the excommunication of Dr. George St. Mivart from the Roman Catholic Church, because he would not revoke articles contributed by him to the *Fortnightly Review* and the *Nineteenth Century*. The formula sent by Cardinal Vaughan to Dr. Mivart for his signature has been published in the London *Times* and is herewith in part reproduced as an explicit statement of what must be believed by communicants in the Roman Catholic Church:

I therefore firmly believe and profess that the Blessed Virgin Mary conceived and brought forth the Son of God in an ineffable manner by the operation of the Holy Ghost, and absolutely without loss or detriment to her Virginity, and that she is reallyand in truth, as the Catholic Church most rightly calls her, the 'Ever Virgin'; that is to say, Virgin before the birth of Christ, Virgin in that birth, and Virgin after it, her sacred and spotless Virginity being perpetually preserved from the beginning, then, and forever afterwards. * * * I firmly believe and profess in accordance with the Holy Council of Trent that the first man Adam, when he transgressed the command of God in Paradise, immediately lost the holiness and justice in which he had been constituted, and that he incurred through that prevarication the wrath and indignation of God, and that this prevarication of Adam injured, not himself alone, but his posterity, and that by it the holiness and justice received from God were lost by him, not for himself alone, but for us all. * * * I reject as false and heretical the assertion that it is possible at some time, according to the progress of science, to give to doctrines propounded by the Church a sense different from that which the Church has understood and understands, and consequently that the sense and meaning of her doctrines can ever be in the course of time practically explained away or reversed.

WE learn from *Nature* that the Reale Institute Lombardo has awarded its prizes as follows: The 'ordinary' prize offered by the Institution for the best catalogue of remarkable meteorological phenomena prior to 1800 was unawarded, but premiums of 400 lire have been awarded to three of the competitors, and the judges consider that the publication of the results arrived at conjointly by the three would be of great value. Under the Cagnola foundation five prizes were offered, and none awarded, the only award being a premium of 1000 lire to the sole competitor who sent in an essay on illustrations of Hertz's phenomena. On two of the other subjects no essays were sent in, and on the other two the essays were not of sufficient merit to justify an award. The Pizzamiglio prize and the Ciani prize, for essays in political science, and the Zanetti prize, for discoveries in pharmaceutical chemistry, are all unawarded. The Fossati prize, for an essay illustrative of the macro- and micro-scopic anatomy of the central nervous system, has been conferred on Dr. Emilio Veratti. In striking contrast to the paucity of competitors in subjects of a more or less academical character is the keen competition for the Brambilla prize, given "to one who has invented or introduced into Lombardy some machine or some industrial process from which the population may derive a real and proved benefit." Seventeen competitors entered for this prize, the awards including a gold medal and 500 lire each to Bianchi and Dubini, for desiccators of silk-cocoons; to

Aurelio Masera, for new processes connected with the textile industry; and to M. Rusconi, for developing the 'Mercer' process in the cotton industry. In addition, gold medals and 400 lire are awarded to Carlo Carloni, for his invention of a mastic called magnesite, as a substitute for red lead for junctions of pipes, also for a bicycle brake; to Demetrio Prada and Co., for extracts used in tanning and for the manufacture of oxygenated water; and to J. Löffler, for introducing into Milan the manufacture of artificial flowers in porcelain. A gold medal and 300 lire is awarded to the Italian Color Manufactory under Max Meyer & Co., and a bonus of 300 lire to E. Tuffanelli, of Milan, for an invention connected with water and gas pipes.

At the Royal Institution on March 2d, Major Ronald Ross delivered a lecture on 'Malaria and Mosquitoes.' According to the London *Times*, he first alluded to the discovery of the parasite of malaria by Laveran in 1880, and the failure of the subsequent attempts to find the parasites in the water and soil of malarious places. He described the theories of King, Laveran, Manson and Bignami that mosquitoes conveyed the disease, and said that it was Manson's theory alone which led to the solution of the problem. Believing that it was the only one of practical value, he undertook to verify Manson's theory, and began work in India in 1895. The task presented many difficulties, but after two and a-half years of failure he at last found the parasites growing in mosquitoes belonging to the genus called *Anopheles*. That was in August, 1897. The following year he completely traced the development of the malaria parasite of birds in the mosquito, and finally, in June, 1898, he succeeded in infecting a number of healthy birds with malaria by the bites of mosquitoes. His investigations had proved that not only the infection itself but the severity of it could be transmitted through the mosquito. Out of 28 healthy sparrows which were used, he succeeded in infecting 22, although he failed to transmit the infection from sparrows to several other kinds of birds. In December, 1898, his investigations were repeated and confirmed by Professor Koch and Professor Grassi, and Drs. Bignami and Bastianelli, who also succeeded in infecting healthy men by the bites of mosquitoes in Italy. The investigations had undergone great development since then. The mosquito theory explained all the facts about malaria.

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## *UNIVERSITY AND EDUCATIONAL NEWS.*

### AN ASSOCIATION OF AMERICAN UNIVERSITIES.

The Chicago *University Record* gives an account of the meeting of representatives of certain institutions held at the University of Chicago, February 27th and 28th. The invitation to this meeting was made by the Presidents of Harvard University, Columbia University, Johns Hopkins University, the University of Chicago, and the University of California. There were present representatives of the University of California, the Catholic University of America, the University of Chicago, Clark University, Columbia University, Harvard University, Johns Hopkins University, Leland Stanford Jr. University, the University of Michigan, the University of Pennsylvania, Princeton University, the Federation of Graduate Clubs, and the United States Commissioner of Education.

After a full discussion, it was unanimously voted that the universities represented in the conference organize themselves into an association. A committee was appointed, consisting of President Jordan, President Harper, Professor Pettie, President Conaty, and Professor Newbold, to prepare the constitution of the association. At an adjourned meeting the following articles were adopted:

#### Constitution.

This organization is called the Association of American Universities.

It is founded for the purpose of considering matters of common interest relating to graduate study.

It is composed of institutions on the North American Continent engaged in giving advanced or graduate instruction.

Its initial membership consists of the following institutions:

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| University of California. | Clark University. |
| University of Chicago. | Cornell University. |
| Columbia University. | Johns Hopkins University. |
| Harvard University. | |
| University of Michigan. | Princeton University. |

University of Pennsylvania.
University of Wisconsin.
Catholic University of America.
Leland Stanford Jr. University.
Yale University.

Other institutions may be admitted, at the annual conference, on the invitation of the Executive Committee, endorsed by a three-fourths vote of the members of the Association.

The Association shall hold an annual conference at such time and place as the Executive Committee may direct.

The Executive Committee shall prepare a program for each meeting.

The officers of the Association shall be: President, Vice-President, and Secretary. These three, with two others elected by the Association, shall constitute the Executive Committee.

In each conference each university may have any number of representatives, but each university shall have a single vote.

No act of the Association shall be held to control the policy or line of action of any institution belonging to it.

After the adoption of this constitution, the following officers were elected for the ensuing year:

For the President of the Association—the Representative of Harvard University.

For the Vice-President—the Representative of the University of California.

For the Secretary—the Representative of the University of Chicago.

For the additional members of the Executive Committee—the Representatives of Columbia University and Johns Hopkins University.

At a meeting of the Executive Committee the Secretary was authorized to communicate with each of the institutions concerned, and to secure, if possible, the formal acceptance by each institution of membership in the Association.

It was decided by the Executive Committee to hold the next annual meeting during the last week of February in the city of Chicago. It was also voted that the meeting should not include more than four sessions, and that each university should be asked to suggest topics for discussion. The following topics were proposed: 'Migration,' 'Fellowships,' 'Subordinate Requirements for the Doctor's Degree,' 'The Printing of Dissertations.'

The Chairman of the Committee was authorized to appoint some person to prepare a statement of facts concerning each topic to be discussed. It was decided that one topic should be taken up for discussion at each session. It was voted that the Association should not appoint a representative for the Paris Exposition, and that it should not undertake at present to secure legislation with reference to the protection of higher degrees. The Federation of Graduate Clubs was given an opportunity to present statements in writing on the topics discussed in the Association.

## GENERAL.

As we announced recently, a school of forestry is about to be established at Yale University. At a meeting of the corporation on March 16th, a gift of $150,000 for this purpose was acknowledged. The donors are Mr. and Mrs. J. W. Pinchot, and their sons, Mr. Gifford Pinchot, '89, and Mr. Amos. R. Pinchot, '97. The donors also authorized the use of a large tract of land in Pike County, Pa., for a summer school. Mr. Henry S. Graves, '92, has been appointed professor of forestry. Mr. Graves is assistant in the Division of Forestry, Department of Agriculture, of which Mr. Gifford Pinchot is chief.

MR. EZRA WARNER, of Chicago, has given $50,000 to Middlebury College, for a science building, the erection of which will be begun at once. Mr. Warner graduated from Middlebury College in 1861.

THE Alumni of Haverford College have subscribed $40,000 for a gymnasium.

IT has been decided that the new laboratory for physiology and anatomy at Cornell University, for which $80,000 was recently given, will be situated in the quadrangle east of Boardman Hall.

THE bequest of about $2,000,000 by the Russian merchant, Mr. Astrachow for the establishment of a university for women at Moscow, has been accepted by the government. It is proposed first to establish faculties of medicine and of science.

THE Michigan Gas Association at its annual meeting in Detroit, February 22d, raised a fund

of six hundred dollars by individual subscription among the members to defray for one year the expenses, at the University of Michigan, of a graduate student who shall spend his time in research along some line of work connected with gas-making or the better utilization of by-products like coal-tar and ammonia. It is the intention of the association to support permanently a research fellowship at the University.

THE corporation of Yale University has made alterations in the curriculum, enlarging the range of elective studies. The requirement of philosophy in the senior year is abandoned, and the range of electives in the sophomore year is enlarged. In the sophomore year ten subjects are offered of which five must be taken and one in addition may be taken. The subjects are, Greek, Latin, French, German, English, history, mathematics (two courses), chemistry and physics.

ARRANGEMENTS have been made for a course on fish culture in connection with the Cornell University College of Forestry. It will be given during two weeks beginning May 7th at Axton in the College forest in the Adirondacks, and will be under the direction of Professor Barton W. Evermann of the United States Fish Commission. The course will consist in a series of daily lectures, with laboratory work, field excursions to the ponds, lakes and rivers, and visits to the State Hatchery at Clear Water, within a few hours of Axton. One or more lectures will be devoted to the following subjects: 1. Natural reproduction among fishes; manner of fertilization; conditions under which spawning takes place; dangers which beset the eggs, the fry and the young; necessity for artificial propagation; natural and artificial methods contrasted. 2. The species of fishes propagated artificially in America; the spawning time, place and habits of each, especially those native to the State of New York. 3. The Salmonidæ, or salmon trout and whitefish; methods of artificial propagation in detail. 4. The Black Bass and other centrarchidæ; methods of culture. 5. The Shad, Wall-eyed Pike, etc. 6. The care of fish fry. 7. Methods of shipment of eggs, fry, fingerlings and adults; how plants of fish are made. 8. Pollution of streams and lakes and fish protection. 9. Fish Culture in America, its history and results.

COURSES in Commercial Education will next year be offered in the University of Michigan. (1) Diplomatic and consular education, (2) higher commercial education, (3) preparation for newspaper work, (4) preparation for pastoral work and public philanthropy, (5) instruction in public administration.

ON the recommendation of Señor Barreiro, secretary for public instruction for Cuba, the school of engineering at Havana is to be reorganized.

WE have already announced the resignation of the Rev. B. L. Whitman, president of Columbian University, Washington, which takes effect at the end of the present academic year. The Rev. Dr. Greene has been chosen president *pro tem.* and Professor H. L. Hodgkins (mathematics and physics) has been elected University Dean.

DR. G. W. MYERS, professor of astronomy at the University of Illinois, has resigned his chair to take charge of the department of astronomy and mathematics in the Chicago Institute.

DR. LLEWELLYS BARKER, associate professor of anatomy at the Johns Hopkins Medical School, has accepted the chair of anatomy and neurology at the University of Chicago.

DR. C. R. BARDEEN, associate in anatomy of the University of California, has been appointed professor of this subject in the University of California.

DR. JOHN ASHHURST, Jr., has resigned the chair of surgery in the University of Pennsylvania.

MR. G. T. MOODY, D.Sc., F.C.S., has been appointed one of the Examiners in Chemistry in the College of Preceptors, London, in the place of Professor W. N. Hartley, F.R.S., who has retired.

DR. WILLY BRUHNS, mineralogy and petrography, and Alexander Tornquist, geology and paleontology, docents at the University of Strassburg, have been appointed to associate professorships.